This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

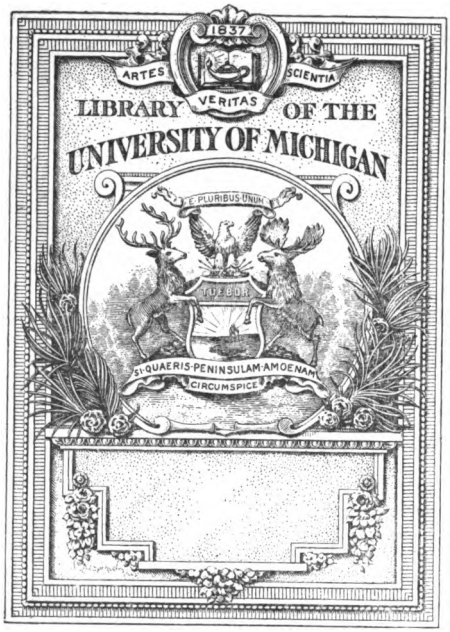
Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

B 431576 DUPL

ANNUAL REPORT
OF THE
NEBRASKA
STATE BOARD OF AGRICULTURE
1897

By ROBERT W. FURNAS.

Digitized by Google



Digitized by Google

S
8S
A

Digitized by Google

Digitized by Google

Digitized by Google

Robt W. Thomas

Digitized by Google

Duplicate

ANNUAL REPORT

NEBRASKA

State Board of Agriculture

FOR THE YEAR 1897.

PREPARED BY

ROBT. W. FURNAS,

Secretary Nebraska State Board of Agriculture.

LINCOLN, NEB.:
JACOB NORTH & CO., PRINTERS.
1898

D' 03
(Doc.)

Digitized by Google

Digitized by Google

STATE BOARD OF AGRICULTURE.

OFFICE OF SECRETARY,

BROWNVILLE, NEB., January 31, 1898.

His Excellency, Silas A. Holcomb, Governor of Nebraska:

SIR—In compliance with the law in this case made and provided, I hereby transmit the annual report of the Nebraska State Board of Agriculture for the year 1897.

Very respectfully,

ROBERT W. FURNAS, *Secretary.*

161431

Digitized by Google

Digitized by Google

PROCEEDINGS.

SEMI-ANNUAL MEETING.

OMAHA, September 25, 1897.

The semi-annual meeting of the Nebraska State Board of Agriculture was, by order of the President, convened at his office on the State Fair grounds, the date above written.

There were present: M. Doolittle, President; J. N. Van Dyne, First Vice President; J. B. McDowell, Second Vice President; Ed. McIntyre, Treasurer; Robert W. Furnas, Secretary.

Other members of the State Board: L. A. Kent, S. C. Bassett, E. A. Barnes, J. B. Dinsmore, M. Dunham, E. M. Searle, J. D. Ream.

Robert W. Furnas and M. Doolittle were appointed delegates to the American Association of Fairs and Expositions, October 29, 1897, Milwaukee, Wisconsin.

John B. Dinsmore was appointed delegate to the American Shorthorn Breeders' Association to meet at Chicago, Ill., in November, 1897.

These delegates were all empowered to attend any and all other live stock associations meeting in Chicago during the Fat Stock show of 1897.

Consideration of holding a state fair in 1898 was postponed until the winter meeting of January, 1898.

President Doolittle appointed as delegates to the Annual State Irrigation Convention to be held at Lincoln, September, 1897: J. B. McDowell, Wm. R. Bowen, J. R. Cantlin, E. L. Vance, L. Morse, E. A. Barnes, M. Dunham, J. N. Van Dyne, Robt. W. Furnas, — Quackenbush.

The President appointed M. Dunham as delegate to the National Irrigation Convention to meet at same time, place, and date as the State Convention.

No further business appearing for consideration, the meeting adjourned *sine die*.

Digitized by Google

ANNUAL MEETING

OF THE

NEBRASKA STATE BOARD OF AGRICULTURE.

LINCOLN, NEBRASKA, January 18, 1898.

In compliance with law, in this case made and provided, the Nebraska State Board of Agriculture convened date and place above named, being "at the capital of the state, on the third Tuesday of January."

OFFICERS PRESENT.

Milton Doolittle, President.
J. N. Van Dyne, first Vice-President.
J. B. McDowell, Second Vice-President.
Ed. McIntyre, Treasurer.
Robt. W. Furnas, Secretary.

MEMBERS OF BOARD PRESENT.

L. A. Kent.	L. Morse.
J. D. Macfarland.	R. W. Furnas.
Ed. McIntyre.	E. A. Barnes.
J. B. McDowell.	J. B. Dinsmore.
Wm. R. Bowen.	M. Dunham.
L. A. Becher.	Austin Humphrey.
M. L. Hayward.	J. N. Van Dyne.
J. R. Cantlin.	E. M. Searle.
E. L. Vance.	W. H. Barger.
M. Doolittle.	Elijah Filley.
S. C. Bassett.	H. D. Kelley.
Chas. Mann.	W. A. Poynter.

Members Barker, Lee, Glover, and Ream were, by vote, excused from attendance.

R. H. Henry tendered his resignation, which was accepted.

January 17, 1898.

Hon. Milton Doolittle, President State Board of Agriculture, Lincoln, Neb.:

DEAR SIR—I believe that the best interests of the State Fair will be served if a younger and better man fills my place, and hereby tender my resignation as a member of the State Board of Agriculture.

Very truly yours,
R. H. HENRY.

Digitized by Google

J. N. Van Dyne, Saline county; E. L. Vance, Pawnee county; Chas. Mann, Dawes county, having been appointed by President Doolittle prior to the meeting of this board, in compliance with the by-laws, a committee on credentials, and to which had been referred the annual reports and credentials sent in by county societies, reported the following presidents and delegates present, entitled to seats and votes in this body. The report, by vote, approved, except in matter of Holt county.

COUNTY.	NAME.
Antelope	L. A. Becher, Delegate.
Boone	L. B. Judd, President.
Brown	D. D. Carpender, President.
Buffalo	B. J. Hubbell, President.
Burt	F. Cameron, President.
Cass	J. H. Becker, President.
Cheyenne	Jno. Dougherty, President.
Cedar	J. H. Inger, President.
Clay	S. O. Phelps, Delegate.
Cuming	C. Rupp, President.
Custer	L. H. Jewett, President.
Dawson	E N. Johnson, Delegate.
Dawes	Chas. Mann, President.
Dodge	E. H. Mead, President.
Douglas	G. R. Williams, President.
Dundy	L. Morse, President.
Fillmore	P. Younger, Delegate.
Grant	John McKenzie, President.
Greeley	C. A. Merch, President.
Hamilton	J. A. McKay, President.
Harlan	E. L. Mean, President.
Hall	Jos. Roach, President.
Hitchcock	C. G. Crews, President.
Jefferson	J. B McDowell, Delegate.
Kearney	M. W. Chappell, Delegate.
Keith	E. M. Searle, Delegate.
Loup	W. W. Mellor, President.
Lancaster	O. W. Webster, President.
Madison	Jas. Stewart, President.
Merrick	N. Withrow, Delegate.
Nuckolls	D. W. Montgomery, President.
Nemaha	Wm. Watson, Jr., President.
Otoe	C. F. Coddington, President.
Pawnee	E. L. Vance, Delegate.
Pierce	W. E. Bishop, Delegate.
Polk	L. R. McGaw, Delegate.

Digitized by Google

COUNTY.	NAME.
Platte	L. H. North, President.
Richardson	V. Arnold, President.
Red Willow	S. R. Smith, President.
Saline	Wm. James, Delegate.
Seward	W. F. Slonaker, President.
Sioux	E. E. Livermore, President.
Thayer	F. C. Hansell, President.
Washington	A. C. Jones, President.
York	W. H. Reader.

The committee reported there were two reports from Holt county, one with W. J. Dobbs, President, and the other, J. A. Frommershausser, President. As there was no one present representing either, no action was taken as to respective claims for recognition.

There being a constitutional number present, the President announced the meeting open for the transaction of business.

Chancellor MacLean, in eloquent and forcible words, welcomed the board, to which Judge Hayward replied in his usual impressive language.

President Doolittle then delivered his annual address as follows:

PRESIDENT'S ADDRESS.

To the Members of the Nebraska State Board of Agriculture:

GENTLEMEN—It has been customary, and I believe is obligatory, according to your by-laws for your president at your annual meeting in January of each year, to render to you in writing a detailed statement of all his official acts in connection with his duties, for inspection.

My first official act after you elected me your president was to appoint a board of managers who should have power and authority to manage and control the interests of, and have a general supervision of the affairs of your organization, subject to your order or that of the president *ad interim*. The power thus vested in your board of managers and their frequent meetings through the year have rendered necessary but few official acts by your president, other than in connection with the Annual State Fair, and my report will therefore be brief. A detailed report of the proceedings of the Board of Managers, kept by the Secretary, is open for your inspection, and a summary of their work will be submitted in his report and that of the chairman of the Board of Managers. Relieved therefore from the necessity of going much into detail, I shall merely submit for your consideration a few suggestions and recommendations which I trust may meet with your approval.

The Thirty-first Annual Nebraska State Fair was held upon the grounds in Omaha from the 17th to 24th of last September, and those of

Digitized by Google

you who were so fortunate as to be there will, I have no doubt, agree with me that in nearly every department it was unquestionably the greatest and most complete exposition of Nebraska products, resources, and possibilities ever brought together on her State Fair grounds. This is not fulsome self laudation, but the concensus of opinion expressed by visitors from our own and sister states. In fact the State Fair of 1897 was in every particular, with but a single important exception which I shall mention later on, perhaps the most successful in the history of its organization.

The exhibition in every department was magnificent; the weather throughout the week was perfect; the machinery of the management in every department never ran more smoothly; expenses were reduced to the minimum, and management, employes, concessionaires, exhibitors, and patrons were all alike pleased. With apparently every condition in our favor, in what, then, did the Fair of 1897 lack of complete success? The one thing lacking was patronage. The attendance was good, but not sufficient to make our receipts equal our expenditures, including premiums offered, and for the first time in its history the Fair management was compelled to scale its premiums. For this unfortunate condition the management can in no wise be blamed. It is their business to provide an attractive exhibit, to properly advertise the Fair, and to keep expenses at the minimum. All this they did; but they could not compel attendance at the Fair. We must, therefore, look for other reasons for lack of attendance. In my opinion the prime cause lies in the distance of the fair grounds from the city of Omaha, and the entirely inadequate facilities for getting to and from the same. Most, if not all, of you who are present here know this to be true from your own experience, and how the matter can be remedied before the holding of the next State Fair is one of deep concern, and should be promptly and carefully considered by the future management.

RECOMMENDATIONS.

I would recommend that the Omaha Street Railway Company be urged to construct a loop at the northeast corner of the fair grounds, together with such an arrangement of gates as will prevent over crowding of cars, by preventing the exit of more than one carload of people at a time, and that every facility and assistance be extended to the street railway company by the fair management to enable them to carry out this plan.

I would recommend the appointment of a committee on legislation whose duty it shall be to draft a bill providing for an appropriation by the state of sufficient funds to pay the evidences of indebtedness issued by this Board for balance of premiums due and to pay the necessary expenses of this Board to the opening day of the next Nebraska State Fair. No state in my knowledge does so little for its State Board of Agriculture as Nebraska. Expenses must be incurred and provided for and contracts entered into up to the opening day of the fair, which cannot be avoided or repudiated after the fair commences, while *we* are practically at the mercy of the wind and weather and other contingencies which might at any time

Digitized by Google

work together to deprive us of our only source of income, the receipts from the fair itself. The great agricultural state of Nebraska should take pride enough in the work being done by her State Board of Agriculture to place them beyond the reach of such unfortunate contingencies as I have alluded to.

APPOINTMENTS.

I appointed Martin Dunham a delegate to represent the Nebraska State Board of Agriculture at the Sixth Annual Session of the National Irrigation Congress held at Lincoln, Neb., September 28 to 30, 1897, and also appointed ten delegates to attend the Fifth Annual Convention of the Nebraska Irrigation Association held at the same time and place. I regret that important business engagements prevented my personal attendance at either of these important conventions.

I trust I may be pardoned for reiterating what has so often been expressed by your Secretary and former presidents, that Nebraska, being peculiarly an agricultural state, the work of its State Board of Agriculture is deserving of the most hearty support and co-operation. You cannot afford to be niggardly with this state institution whose province it is to "provide and care for the cause of agriculture in all its various branches throughout the state." If you restriot it to meagre means and insufficient equipment you must in like measure restrict and impair its usefulness. You should not be compelled to ask for the means with which to carry on your work. It should be generously and freely provided. I would recommend that the committee on legislation before mentioned prepare an amendment to the present state law governing your body, to be presented for passage at the next session of the state legislature, providing for an annual appropriation by the state of a sum sufficient to enable your Board to carry on its work and increase its usefulness, without being obliged to rely upon the precarious and uncertain revenue derived from gate receipts of the State Fair, of which we are at any time likely to be deprived by conditions or circumstances which we cannot by any possibility control.

In our neighboring state of Iowa, a bill, I understand, is prepared and will be introduced in the coming session of their state legislature, providing that all expenses of the State Board of Agriculture shall be paid by the state, and that there shall be free admission to the State Fair grounds at the annual exhibition. This would no doubt seem to be a radical departure from present methods, but I will frankly say that my personal views for years have been in consonance with this idea. If the state fair is a state institution, as it *is* in our state, let it be supported by the state, as other institutions are; if not, let the state go out of the fair business and trust to individual enterprise to make proper exhibitions of the state products and resources.

The coming Trans-Mississippi Exposition, to be held in this city of Omaha during the present year, shows every promise of being a signal success. Although your board as a body has no official connection with the Exposition, I would still suggest and recommend that in a true spirt

Digitized by Google

of loyalty to our beloved state and her best interests, every individual member of this board do all within his power to make Nebraska's showing commensurate with her reputation as an agricultural state.

I cannot close without alluding to my pleasurable and harmonious association with the other officers elected by you and selected by myself to manage your affairs during the past year. The (if I may be allowed to call it such) *esprit de corps* of the Nebraska State Board of Agriculture has always been one of its strongest features, and in no year has it ever been more in evidence than in the one just closed. Every individual member and officer of this Board within my knowledge has labored disinterestedly for the advancement of the purpose for which this body was created; and I now retire from the office to which it was your pleasure to elect me one year ago with the most kindly regard for each and every one of you.

Respectfully submitted,

MILTON DOOLITTLE,
President.

Treasurer McIntyre then presented his annual report as follows:

ANNUAL STATEMENT OF THE TREASURER

OF THE NEBRASKA STATE BOARD OF AGRICULTURE, JANUARY 18, 1898.

To cash on hand January 19, 1897	$ 332 93
" amount borrowed	2,500 00
" annual state apportionment	2,000 00
" amphitheatre general receipts	2,157 50
" amphitheatre reserved seat receipts	403 00
" amphitheatre special receipts	187 75
" booth department	2,347 50
" camp permits	10 50
" forage department	391 00
" general admission tickets	14,672 00
" concessionaires' tickets	347 60
" quarter stretch tickets	203 50
" B. & M. R. R. coupons	2,133 50
" F., E. & M. V. R. R. coupons	1,663 00
" C., R. I. & P. R. R. coupons	391 00
" C., St. P., M. & O. R. R. coupons	1,058 25
" Mo. Pacific R. R. coupons	1,108 50
" Union Pacific R. R. coupons	1,425 00
" speed department	3,312 54
" stalls	1,278 42
" score cards	75 00
" supply wagons	71 00
" dray wagons	23 00
" refund of warrant No. 207	154 50
" rent of cots used by Treasurer	6 75

Digitized by Google

To refund police pay roll overdrawn		$ 89 00
" W. R. Bennett & Co., tickets		7 50
" Richardson Drug Co., tickets		40 40
" M. Doolittle, refunded		24 00
" O. F. and speed association account, switching		336 05
" J. H. Steiner, account speed penalties		88 85
Total		$38,839 54
By warrants paid, series 1896	$ 2,270 67	
" warrants paid, series 1897	35,111 01	
To balance	1,448 86	
		$38,839 54

Respectfully submitted,

EDMUND MCINTYRE,
Treasurer.

The Secretary here presented his annual report as follows:

SECRETARY'S ANNUAL REPORT.

To the Nebraska State Board of Agriculture:

As required by section 6, By-laws of this Board, I hereby submit my annual report for the year ending December 31, 1897.

FINANCIAL.

The total receipts for the year ending December 31, 1897, including the state appropriation, $2,000, and balance on hand from 1893, $332.95, was $38,839.54. Net receipts for the year 1897, excluding state appropriation and balance on hand, was $36,506.61. Total expenditures and liabilities for the year 1897 was $39,375.32. Receipts not meeting expenditures, payments were made as follows:

Expenditures other than for premiums, $23,110.81, were paid in full. Premiums, total awarded, $16,264.51; $8,882.35 of this total award were paid, 55 per cent cash, $4,885.29, and 45 per cent, $3,997.06, with evidences of indebtedness, payable November 1, 1899, bearing 6 per cent interest from date, November 1, 1897. Total premiums paid in cash, $12,267.45.

As a part of this report, accompanying, will be found a detailed list of all warrants for the year 1897, showing date of issue, number of warrant, to whom issued, and for what purpose. Also a list of evidences of indebtedness for unpaid premiums, to whom issued, and amount of each.

Expenditures, other than for premiums, are epitomized as follows:

COST OF FAIR GROUNDS, $2,758.34.

This covers all improvements, repairs, lumber, other material, labor, cleaning grounds, water works, and water supply, etc.

PAY ROLLS, $4,683.22.

This item embraces pay rolls of police, gate-keepers, clerks to treasurer, secretary, superintendents, judges, experts, and their expenses, clerks to committees, etc.

Digitized by Google

PRINTING, STATIONERY, OFFICE SUPPLIES, ADVERTISING, ETC., $3,298 18.

This factor of expenditures includes all printing: premium lists, hangers, dodgers, circulars, novelties, tickets, advertising, posters, engraving, and all kindred supplies for all officials.

MISCELLANEOUS, $4,563.85.

Under this head is included $2,500 borrowed money and interest, per cent paid booth manager, dues to American Trotting Association, speed supplies, speed penalties collected for other tracks, entrance, stall, pen, and other moneys refunded.

ATTRACTIONS, $687.

Paid for bands and Jubilee Singers.

LIVERY, $23.

This for horses and conveyences used by officials preparing grounds and for use during fair.

HOTEL EXPENSES, $925.70.

Paid hotel bills for entire state board during winter meeting, managers during entire year, experts, judges, and those serving without compensation.

SALARIES, $3,250.

This is for fixed salaries paid President, Treasurer, Board of Managers, and Secretary.

FORAGE, $300.45.

This sum was paid for forage purchased. There was sold $391. This leaves the net cost of forage $109.45.

SWITCHING, $336.05.

This item was paid switching exhibits, and reimbursed by the Omaha Fair and Speed Association. This as to car lots only.

APPROPRIATION, $1,600.

This embraces $800 paid State Horticultural Society, and $100 each to seven scientists; botanist, entomologist, geologist, meteorologist, zoologist, veterinarian, and engineer for the Board, and $100 in aid of farmers' institutes.

FREIGHT, TELEGRAPH, EXPRESS, AND CARTAGE, $360.77.

This for all freight, express, cartage, and telegraph for the whole year.

POSTAGE, $324.25.

This paid for mailing annual reports, bulletins, hangers, circulars, diplomas, medals, fair posters, and kindred matter sent through the mails.

Digitized by Google

CROPS OF 1897.

In the matter of full crop report to date of annual meetings, for reasons heretofore given, and still existing, this cannot be accurately done. Not one-fourth of returns due from counties in the state have been rendered, and not a single one more than half completed.

These are never sent in as required by law and the regulations of this State Board. Universally, after all obtainable from this source is received by your Secretary, he spends months afterward in endeavors in other directions to secure data for the annual report.

While this Annual Report is quite as good and reliable as other states collect and promulgate, it is far from being perfect or satisfactory to the compiler. The same difficulty I find, from correspondence with U. S. Secretary of Agriculture, prevails in national statistics. Thus it will ever be until a statutory law provides and compels, under penalty, collection and record of crop statistics, by some authorized persons in each precinct in the state. To this end your secretary has prepared bills for acts and presented various legislatures for enactment, but failed in securing passage.

For this report I here present, however abbreviated, yield estimates, based on as reliable information, and from as reliable sources as at command and obtainable, referring to leading crop factors in the state for the year 1897. I state in round numbers, and all below the fractions, notably:

Corn	231,000,000	bushels
Wheat	43,000,000	"
Oats	71,000,000	"
Rye	5,500,000	"
Barley	3,000,000	"
Flax seed	225,000	"
Potatoes	9,000,000	"
Hay, including both tame and wild grasses	5,000,000	tons
Sugar beets	98,000	"
Beet sugar	13,500,000	pounds
Chicory, the raw product	6,000	tons

There are numerous other and minor factors which will be embraced and presented in the annual volume for 1897. This volume it is designed to make more elaborate than any heretofore, both in the list of products and their values.

Prices of course vary more or less in various parts of the state. Our annual volume for 1897 will contain the average prices for the state of various crops.

With the exception of wheat, prices have not been what producers desire, and what they should, to render farming as remunerative as may be.

In live stock the increase in numbers, for 1897, over that for 1896 has been handsome. The prices in certain lines of good horses have increased

Digitized by Google

materially. More notably in draft and roadster classes of best breeds, or high grades therefrom.

In short, the crops in Nebraska for 1897 were encouraging, both in respect to yield and quality; and the outlook brighter rather than otherwise.

THE NEBRASKA STATE FAIR FOR 1897.

The exhibit in itself was conceded by all who personally witnessed, to be the largest, best, most representative and instructive presentation of the products, resourses, and possibilities of the New West, more particularly for Nebraska, agriculturally, ever presented. The weather was ideal in all respects. And yet with all these favorable environments, from a financial standpoint, resulted most disastrously; surprised all fair makers and fair patrons. The Board for the first time in its history of thirty-three years work was compelled to scale a portion of its premiums, paying 55 per cent in cash, and 45 per cent in "promises to pay." The public very naturally wish to know, and is entitled to know, why such results.

I have never permitted personal feelings or interests to intervene in the discharge or consideration of official or public duties. From such standpoint I here venture to narrate a line of facts in this matter I opine none will undertake to controvert. In so doing I will not enter into any of the differences that have existed, and do exist, between the fair management and the association at Omaha, with which it is called to deal, certain newspaper criticisms relating thereto, and other etceteras; simply facts in connection with the location of the fair at Omaha, and attending conditions surrounding the three fairs held since there located, viz.: 1895, 1896, and 1897.

The location of the present fair grounds was objected to by the committee from the State Board, of which I was one member, for the reason of its distance from Omaha, South Omaha, and Council Bluffs. On the assurance, however, and which was made a part of the written contract between this Board and the Omaha Fair and Speed Association that transportation facilities for reaching the grounds, both by regular steam railway and electric motor lines, "ample to accommodate 100,000 people daily," and that all railroad switching of exhibits should be free to this Board and fair exhitors, and at rates not to exceed five cents each way for passengers, would be provided. The proposition was for one, I confess, reluctantly accepted, relying somewhat on the theory that in this progressive age, distances may be measured by minutes rather than by miles.

It was agreed that all accommodations for holding fairs should be provided by the Omaha Fair and Speed Association.

"Water to be provided sufficient in all parts of the grounds, as requested, free of cost to your association."

"The rate of fare between Omaha, South Omaha, and Fair Grounds via the Missouri Pacific Railway, from Webster Street Depot, and via the Union Pacific Railway, between Union Depot and Fair Grounds, shall not exceed five cents for one fare one way, or ten cents for the round trip."

Digitized by Google

"All repairs necessary during the term of five years will be made, as required by you, at our expense."

The grounds were well arranged, well enclosed, and the buildings in design excellent and well built, with exceptions of roofs, all of which leaked badly, injuring many exhibits. None of these propositions above referred to have been fulfilled. The buildings with bare walls were turned over to this Board with a flat refusal to prepare the interiors for occupancy for fair purposes, and that at too late a date for this Board to find a remedy. The result was the management was compelled to spend over $7,000 in labor and material, which should have been done by the Omaha Fair and Speed Association for the first year 1895. Similar failures, to less extent it is true, for the years 1896 and 1897 largely followed.

For the first fair, that of 1895, the motor line of transportation particularly, and on which fair patrons largely depended, was a most signal failure in meeting the demand. In fact, all transportation facilities fell far short of the promises given and upon which the fair location was made. And yet, as this was the first fair held at Omaha for ten years, being new and novel, the receipts were such as to enable the management to pay out. There was, however, on the part of both fair makers and fair patrons, not excepting residents of Omaha, a general denouncement of fair location and means of transportation.

A remedy in transportation was promised for the fair of 1896, and partially provided, but in no wise meeting the emergency. The consequence was receipts were $12,231.65 less than in 1895. The fair of 1896 was behind, financially, thousands of dollars.

For the fair of 1897 extraordinary efforts were made by the fair management to present an unprecedented exposition. This was done most effectually. Weather conditions were all that could be desired; transportation facilities had not been improved, and receipts fell still below the fairs of 1895 and 1896, leaving the State Board largely in debt; in 1897 being $2,087.53 less than 1896, and $14,387.08 less than 1895.

It is but fair to all concerned to state other conditions that have come into existence at Omaha since the location of the State Fair. Since the first fair of 1895, the interesting and attractive spectacular display of the Omaha Ak-Sar-Ben Association and other entertainments were organized and successfully executed on the streets of Omaha during evenings of fair week, 1896 and 1897, greatly to the credit and enterprise of Omaha people. These all distracted, however, to be frank, from the State Fair. Then the Trans-Mississippi and International Exposition, another instance of commendable enterprise and progress, sprang into existence and from its location to be at Omaha, within "a stone's throw" of fair grounds together with the spirit with which it is being handled, can but result, as it should, in success. This really detracted largely locally and to my personal knowledge from the fair of 1897. Of this no one does or should complain. It is characteristic of the money enterprises of Omaha. All these new conditions, not existing, when the fair was located at Omaha, nor at

Digitized by Google

the time of the fair of 1895, have and do contribute to destroy fairs at present location under present contract.

I desire in this connection to express my individual impression as to transportation facilities to and from present fair grounds. The lines, both railroad and motor, have done all they can afford to do, assuming they invest and operate from a purely business standpoint. They cannot afford expenditure required to meet the demand, and use only for five days in a year.

Location of grounds is most unfortunate. This was and is conceded by not only the people of the state, but those of Omaha, outside interested manipulators who caused the present location. None complain of the grounds, in the abstract, or their equipments; they are excellent; but few State Fair grounds in the United States are better.

I have long thought, often expressed, and here reiterate the conviction that the Nebraska State Board of Agriculture should cease engaging in fair business, and in keeping with the progressing spirit of the age, advance a step higher, resolve itself into a bureau of agricultural statistics and information, leaving fairs to individual enterprise. Not that I have in any way lost an iota of my faith in fairs and expositions as great educators and object lesson high schools and universities. State fairs held under the auspices of state law and government, not only in Nebraska but other states, have been the causes of bickerings and dissensions not productive of best results, and will ever continue so under existing conditions. All this is in reality more applicable to Nebraska than to any other state. The state contributes less to the Board's assistance than any other in the Union, and the Board improvises more in matters of revenue and recourses financially; in fact, in substance, improvises every dollar for its support. The public generally is not aware of this, and when unfavorable weather conditions or other, by the Board, uncontrollable environments, fairs do not pay out, the management is too often charged with incompetency and dishonesty. In other states in instances of failures as indicated, they have a goodly annual state appropriation to fall back on and use to liquidate deficiencies. To meet such emergencies the Nebraska State Fair managers have for several years borrowed money in sums of thousands of dollars annually, and on their individual responsibility.

The Board is doing valuable work in matters of statistics and general agricultural information in the publication of its annual printed volumes of four hundred pages, which are distributed free to all desiring. These publications are regarded by others than the editor as among the most valuable of such state publications. They are sought for, and used in most of the schools in Nebraska as text-books. Also called for, and used in other states, for same purposes. During the last year I have responded to calls from New York, Massachusetts, Illinois, Ohio, and Iowa. The scientific department of these volumes, made so by the valuable contributions of the Board's able corps of scientists, is conceded by all familiar

Digitized by Google

to be without superior. I risk the charge of egotism in stating these volumes are volunteer work entire, on the part of your present Secretary. There is no law of the state, or order of the Board, requiring this work on his part.

They are distributed annually to all public libraries in the United States, and to all agricultural and kindred newspaper publications in the world. While being far from perfect, I repeat, or satisfactory to the compiler, they are the best obtainable under existing conditions. The Board will bear me witness I have, for years past, called attention to the necessity of a law providing for collecting and diffusing more detailed and accurate agricultural statistics. No better agricultural region of country exists than within the geographical limits of Nebraska. The public should know more of its excellence. It can learn no more advantageously than through mediums here indicated.

As the shortest and most equitable way out of existing State Fair entanglements, I am free to express, unbiased, the conviction that to declare off for the years 1898 and 1899, under to be devised mutually agreed conditions, will be the part of wisdom. To those at all versed in fair matters, an attempt to hold a fair in the autumn of 1898, with the Trans-Mississippi Exposition in session within a few miles of the present State Fair grounds at Omaha, would simply be folly in the extreme. For the year 1899 it would be equally unwise, for the reasons that fair makers and fair patrons will have been so thoroughly overtaxed in contributing, as they should, both time and means in support of the Trans-Mississippi Exposition, that they cannot in any way further contribute to an extent commensurate with requirements for success.

Beside these latter considerations, I am firmly of opinion a successful fair cannot be held on present fair grounds without more perfect means of transportation to and from, and more exact compliance with existing contract stipulations as well.

Before 1900 another state legislature will convene, at which the law governing the State Board of Agriculture, to meet growing demands, should be thoroughly remodeled; and among other things the factor of continuing State Fair under state auspices determined.

In the meantime let the Board continue statistical work and diffusion of agricultural information as best it can.

ROBT. W. FURNAS IN ACCOUNT WITH STATE BOARD OF AGRICULTURE, 1897.

Dr.

Speed	$3,312 54
Stalls and pens	1,278 42
Booths	2,347 50
State appropriations	2,000 00
Forage	391 00
Switching refunded	333 05
Barns returned	154 50
Speed penalties collected	88 85

Digitized by Google

Score card	$ 75 00
Overdrawn police pay roll	89 00
Richardson special tickets	40 40
Returned by Doolittle	24 00
Corning and Adams	10 50
Cot rents	6 75
Bennett tickets	7 50
Supply wagons	71 00
License	23 00
	$10,256 01

Cr.

By Treasurer's receipts to balance, $10,256 01.

LIST OF WARRANTS—1897.

DATE.	TO WHOM ISSUED.	NO.	FOR WHAT PURPOSE	MISC.	PREM.
Jan. 20	M. Dunham	1	Services State Fair, '95-96	$ 208 00	
Jan. 22	Austin Humphrey	2	Hotel bill	274 00	
Jan. 23	J. P. Cooke & Co	3	Rubber stamps	3 00	
Jan. 23	W. D. Mann	4	Services	3 80	
Jan. 23	Milton Doolittle	5	Sundries	5 95	
Jan. 23	Fred August	6	Cartage, Aug. 31 to Dec. 31	8 95	
Feb. 2	Alice Mooney	7	Postage for January, 1897	4 82	
Feb. 2	John B. Lewis	8	Ft., Tel., and Ex., January	4 10	
Feb. 19	Hotel Lincoln	9	Hotel bill	16 00	
Feb. 19	Rees Printing Co	10	Printing	12 50	
Feb. 19	State Journal Co	11	Printing supplies	16 25	
Feb. 19	J. P. Cooke & Co	12	Rubber stamp	50	
Feb. 19	Mer. Transfer Co	13	Cartage	1 50	
Feb. 23	Robt. W. Furnas	14	Salary and allowance, January	216 00	
Mar. 1	Robt. W. Furnas	15	Salary and allowance, February	216 00	
Mar. 2	Lloyd Royse	16	Postage, February, 1897	5 37	
Mar. 2	J. M. Lewis	17	Frt., Tel., and Ex., February	10 80	
Mar. 16	Rees Printing Co	18	Supplies	13 25	
Mar. 19	Nims Bros	19	Premiums		72 50
Mar. 20	Omaha Bee	20	Advertising	2 00	
Mar. 20	World Herald	21	Advertising	2 00	
Mar. 31	L. Bruner	22	Entomologist	100 00	
April 1	Robt. W. Furnas	23	Salary and allowance, March	216 00	
April 5	Lloyd Royse	24	Postage for March	4 90	
April 6	John B. Lewis	25	Frt., Tel., and Ex., March	7 81	
April 16	S. C. Bassett	26	Incidentals	7 55	
April 16	M. Doolittle	27	Incidentals	9 80	
April 16	W. A. Poynter	28	Incidentals	4 45	
April 20	J. B. Dinsmore	29	Floral design	18 00	
April 23	Stowel & Kent	30	Printing envelopes	3 00	
April 23	Rees Printing Co	31	Printing	44 32	
April 23	Rees Printing Co	32	Printing	49 28	
April 23	Klopp & Bartlett Co	33	Stationery	16 15	
April 23	Klopp & Bartlett Co	34	Stationery	114 05	
April 23	J. B. Stanton	35	Lost Cheese	2 00	
April 30	State Journal Co	36	Advertising	7 50	
May 1	F. D. Read	37	Printing	12 25	
May 1	Robert W. Furnas	38	Salary and allowance, April	216 00	
May 1	John B. Lewis	39	Ft., Tel. and Ex., April	7 52	
May 1	Lloyd Royse	40	Postage for April	3 80	
May 13	Henry B. Ward	41	Scientist	100 00	
June 1	Robert W. Furnas	42	Salary and allowance, May	216 00	
June 1	J. B. Lewis	43	Ft., Tel. and Ex., May	25 43	
June 1	Lloyd Royse	44	Postage for May	3 05	
June 4	E. L. Vance	45	Incidentals	3 85	
June 4	E. A. Barnes	46	Incidentals	4 45	

Digitized by Google

LIST OF WARRANTS, 1897—*Continued.*

DATE.	TO WHOM ISSUED.	NO.	FOR WHAT PURPOSE.	MISC.	PREM.
June 4	M. Doolittle	47	Incidentals	2 65	
June 8	J. Manz & Co.	48	Engraving	10 08	
June 3	Klopp & Bartlett Co.	49	Stationery	9 00	
June 3	Koerner & Hayes	50	Hangers, 1897	490 50	
June 3	Nat. Ry. Pub. Co.	51	Railroad guide	5 00	
June 3	Wright & Thomas	52	Attorney fees	5 00	
June 3	Omaha Engraving Co	53	Engraving	4 00	
June 3	C. H. Forby	54	Mail sack	2 90	
June 3	Robert W. Furnas	55	Supplies	5 10	
June 3	Rees Printing Co.	56	Supplies	60 50	
June 3	Rees Printing Co.	57	Supplies	24 60	
July 1	Robert W. Furnas	58	Salary and allowance for June	216 00	
July 1	Lloyd Royse	59	Postage, June	153 47	
July 5	G. A. Loveland	60	Farmers' institute	100 00	
July 5	John B. Lewis	61	Ft., Tel. and Ex., June	30 18	
July 8	Buffalo Co. Beacon	62	Printing	165 00	
July 8	Buffalo Co. Beacon	63	Printing	17 25	
July 8	W. A. Poynter	64	Incidentals	1 35	
July 12	E. H. Barbour	65	Scientist	100 00	
July 12	A. Hospe	66	Frames	6 80	
July 12	Rees Printing Co.	67	Prepaid envelopes	121 80	
July 12	Rees Printing Co.	68	Printing	15 50	
July 13	Fred August	69	Cartage, January 1 to June 30	19 45	
July 17	Mathews Northrup Co	70	Circular	15 00	
July 19	And. Kiewit	71	Premium List	149 20	
July 20	J. B. Lewis	72	Frt. Tel., and Ex., July 1-16	28 54	
July 29	J. B. Dinsmore	73	Addis expense	125 00	
July 29	C. J. Emery	74	Expense Bulletin	43 50	
Aug. 2	Robt. W. Furnas	75	Salary and allowance, July	216 00	
Aug. 3	Lloyd Royse	76	Postage for July	90 58	
Aug. 24	W. H. Harrison	77	Railroad fare	8 80	
Aug. 24	G. W. Pace	78	Railroad fare	5 16	
Aug. 24	C. J. Emery	79	Bulletin Expense	43 75	
Aug. 24	J. B. Lewis	80	Ft., Tel., and Ex., July 16-31	29 91	
Aug. 24	E. A. Barnes	81	Advertising	40 00	
Aug. 24	M. Doolittle	82	Incidentals	6 70	
Aug. 24	S. C. Bassett	83	Advertising expense	5 25	
		84	Void		
Aug. 28	Colman's Rural World	85	Advertising	5 00	
Aug. 28	Mathew&NorthrupCo.	86	Novelties	15 00	
Aug. 28	Shelton Clipper	87	Speed program	26 00	
Aug. 28	W. D. Mann	88	Cash paid to balance account	2 50	
Aug. 28	Breeders' Gazette	89	Advertising	10 00	
Aug. 28	Iowa Homestead	90	Advertising	10 00	
Aug. 28	Horse Review	91	Advertising	11 25	
Aug. 28	Rees Printing Co.	92	Stamped envelopes	3 25	
Aug. 28	Rees Printing Co.	93	Printing	241 85	
Aug. 28	Am. Trotting Ass'n	94	Fees, 1897	75 00	
Sept. 1	Robt. W. Furnas	95	Salary and allowance, for August	216 00	
Sept. 1	Lloyd Royse	96	Postage, August	30 20	
Sept. 4	J. B. Lewis	97	Ft., Tel., and Ex., August	38 56	
Sept. 4	A. T. Peters	98	Veterinarian	100 00	
Sept 19	C. J. Emery	99	Expense bulletin	30 00	
Sept. 17	W. D. Mann	100	Apply on pay roll	125 00	
Oct. 14	Carter Hardware Co.	101	Supplies	156 28	
Oct. 20	M. H. Collins	102	Cushions	155 20	
Oct. 20	Wolfe Bros. Co.	103	Use of tents	154 00	
Oct. 20	D. T. Mount	104	Superintendent speed	50 00	
Oct. 22	Geo. A. Hoagland	105	Lumber	256 82	
Oct. 22	Millard Hotel	106	Hotel bill	68 10	
Oct. 22	W. J. Connell	107	Attorney fee	50 00	
Oct. 22	Aultman Taylor Co.	108	Power	100 00	
Oct. 22	Om. Mer. & Ex. Co.	109	Drayage	60 85	
Oct. 22	Robt. W. Furnas	110	Typewriting extras	5 39	
Oct. 22	F. A. Nims	111	Photo of fair	10 00	
Oct. 22	Fred August	112	Cartage, July 1 to September 30	9 85	
Oct. 23	Nat. Ry. Pub. Co.	113	Railroad guide	5 00	
Oct. 23	Omaha Eng. Co.	114	Engraving	2 00	
Oct. 23	Western Rural	115	Advertising	10 00	
Oct. 23	Edgar Allen	116	Superintendent Merchant's Hall	40 50	

Digitized by Google

LIST OF WARRANTS, 1897—*Continued.*

DATE.	TO WHOM ISSUED.	NO.	FOR WHAT PURPOSE	MISC.	PREM.
Oct. 23	C. F. Curtis	117	Expert	38 50	
Oct. 23	G. W. Hervey	118	Superintendent Alfalfa Palace	40 00	
Oct. 23	Pokrok-Zapadu	119	Advertising	25 00	
Oct. 23	Bee Publishing Co	120	Advertising	40 00	
Oct. 23	News Publishing Co	121	Advertising	25 00	
Oct. 23	State Journal Co	122	Supplies	12 25	
Oct. 23	Spirit of the West	123	Advertising	10 00	
Oct. 23	T. L. Lyon	124	Expert	24 00	
Oct. 23	A. C. Jones	125	Bal. Supt. Agr. Hall	10 00	
Oct. 23	W. D. Mann	126	Labor	71 65	
Oct. 23	A. C. Ziemer	127	Premium		50 00
Oct. 23	C. A. Bessey	128	An. Allowance	100 00	
Oct. 23	G. D. Swezey	129	Scientist	100 00	
Oct. 23	O. V. P. Stout	130	Scientist	100 00	
Oct. 26	T. Andrews & Son	131	Premiums		41 80
Oct. 26	Ben Aldritt	132	Premiums		6 60
Oct. 26	P. C. Aylesworth	133	Premiums		6 60
Oct. 26	Arnold Bros	134	Premiums		12 32
Oct. 26	E. H. Andrews	135	Premiums		4 84
Oct. 26	W. A. Armstrong	136	Premiums		15 18
Oct. 26	W. R. Anthony	137	Premiums		1 10
Oct. 26	Mrs. L. L. Allen	138	Premiums		5 06
Oct. 26	Mrs. Josephine Allen	139	Premiums		3 30
Oct. 26	Fred Allen	140	Premiums		1 10
Oct. 26	Frank A. Burt	141	Premiums		15 32
Oct. 26	James Barrett	142	Premiums		4 40
Oct. 26	Ben Buercher	143	Premiums		1 10
Oct. 26	J. Bolleau & Sons	144	Premiums		13 00
Oct. 26	J. Bolleau & Sons	145	Premiums		29 07
Oct. 26	George Bothwell	146	Premiums		14 08
Oct. 26	W. E. Brown	147	Premiums		18 84
Oct. 26	J. Benson & Son	148	Premiums		8 72
Oct. 26	R. L. Blodgett & Son	149	Premiums		1 32
Oct. 26	C H. Ballinger	150	Premiums		34 24
Oct. 26	W. J. Boynton	151	Premiums		18 26
Oct. 26	F. E. Baldwin	152	Premiums		9 24
Oct. 26	C. E. Boggs	153	Premiums		82
Oct. 26	A. P. Brady	154	Premiums		4 96
Oct. 26	Oscar Bock	155	Premiums		82
Oct. 26	J. C. Babler	156	Premiums		2 64
Oct. 26	Wm. Bostain	157	Premiums		1 65
Oct. 26	Buck Brothers	158	Premiums		27 83
Oct. 26	O. N. Burkett	159	Premiums		3 41
Oct. 26	J. H. Blodgett	160	Premiums		7 92
Oct. 26	S. D. Bouvier	161	Premiums		3 79
Oct. 26	J. Ballard	162	Premium and switching		19 61
Oct. 26	N. E. Bartholomew	163	Premiums		12 15
Oct. 26	J. P. Brown	164	Premiums		1 32
Oct. 26	W. T. Brown	165	Premiums		1 32
Oct. 26	B. F. Bill	166	Premiums		1 65
Oct. 26	D. N. Blood	167	Premiums		1 65
Oct. 26	Mrs. O. E. Bunnell	168	Premiums		82
Oct. 26	Mrs. J. H. Blodgett	169	Premiums		3 47
Oct. 26	Mrs. Mary Baroch	170	Premiums		27
Oct. 26	Edith Blunk	171	Premiums		27
Oct. 26	Mrs. Hanna Balliet	172	Premiums		1 10
Oct. 26	Mrs. Maggie Bishop	173	Premiums		3 30
Oct. 26	Mrs. M. A. Bock	174	Premiums		82
Oct. 26	Millie & Mabel Brown	175	Premiums		10 17
Oct. 26	M. M. Butterfield	176	Premiums		21 06
Oct. 26	Mrs. G. F. Bergner	177	Premiums		1 37
Oct. 26	Mrs. W. J. Bradbury	178	Premiums		27
Oct. 26	Mrs. E. C. Barr	179	Premiums		1 65
Oct. 26	Mrs. Clara Belden	180	Premiums		2 20
Oct. 26	Martha L. Baker	181	Premiums		1 32
Oct. 26	Mrs. A. L. Burr	182	Premiums		1 10
Oct. 26	Mrs. H. P. Bruner	183	Premiums		3 30
Oct. 26	Nellie A. Barnum	184	Premiums		1 32
Oct. 26	Boone County Ag. So.	185	Premium and switching		101 83
Oct. 26	I. W. Chappell	186	Premium and Switching		24 45

Digitized by Google

LIST OF WARRANTS, 1897—*Continued.*

DATE.	TO WHOM ISSUED.	NO.	FOR WHAT PURPOSE.	MISC.	PREM.
Oct. 26	W. H. Chapman	187	Premiums		10 89
Oct. 26	C. A. Cook	188	Premiums		10 00
Oct. 26	A. W. Covall & Son	189	Premiums		82
Oct. 26	U. Cachlein	190	Premiums		7 04
Oct. 26	S. G. Culbertson	191	Premiums		82
Oct. 26	J. E. Carey	192	Premiums		82
Oct. 26	P. Chancy	193	Premiums		82
Oct. 26	George Cant	194	Premiums		55
Oct. 26	J. Carley	195	Premiums		1 10
Oct. 26	James Collin	196	Premiums		55
Oct. 26	L. M. Copeland	197	Premiums		2 20
Oct. 26	C. Carpenter	198	Premiums		1 10
Oct. 26	George Cowles	199	Premiums		1 10
Oct. 26	Crete Mills	200	Premiums		1 65
Sept. 19	E. McIntyre, Treas.	201	Interest	118 20	
Sept. 20	W. A. Poynter	202	Expenses	16 45	
Sept. 20	E. McIntyre, Treas.	203	Refund	31 00	
Sept. 20	F. F. Blakeslee	204	Electric bell	6 50	
Sept. 20	E. McIntyre, Treas.	205	Refund	9 50	
Sept. 20	V. W. Leach	206	Painting sign	11 00	
Sept. 21	Eli A. Barnes	207	Redemption coupon	180 00	
Sept. 21	E. McIntyre, Treas.	208	Refund	4 50	
Sept. 21	Leopold Doll	209	Rent of land	30 00	
Sept. 22	W. D. Mann	210	Pay roll	100 00	
Sept. 22	A. J. Lovejoy	211	Judge Class C	57 74	
Sept. 22	W. G. Johnson	212	Judge Class C	46 30	
Sept. 22	F. H. Shelbarger	213	Judge Class E	40 00	
Sept. 22	E. M. Searles	214	Pay roll	100 00	
Sept. 22	Slayton Jubilee Sing.	215	On account	150 00	
Sept. 23	P. Sheldon	216	Judge Class A	25 00	
Sept. 23	George Pace	217	Police pay roll	300 00	
Sept. 23	Joseph Watson	218	Judge Class A	24 40	
Sept. 23	Theo. Hewes	219	Judge Class E	40 00	
Sept. 23	G. H. Eckles	220	Judge Class E	23 50	
Sept. 24	Omaha Nat. Bank	221	Borrowed money	2500 00	
Sept. 24	Wausa Band	222	Services	12 00	
Sept. 24	E. H. Eggert	223	Premiums		30 00
Sept. 24	E. Reynolds & Son	224	Premiums		80 00
Sept. 24	E. McIntyre, Treas.	225	Treasurer's pay roll	331 50	
Sept. 24	C. H. Elmendorf	226	Premium		50 00
Sept. 24	Benj. Whitsitt	227	Judge Class B	43 50	
Sept. 24	S. B. Moffatt	228	Clerk to Secretary	24 00	
Sept. 24	J. T. Nickerson	229	Clerk to Secretary	18 00	
Sept. 24	W.G.McCandless&Son	230	Premium		70 00
Sept. 24	T. R. Westrope	231	Premium		35 00
Sept. 24	Jas. Boileau & Sons	232	Premium		50 00
Sept. 24	F. M. Shinn	233	Judge Class O	16 20	
Sept. 24	J. M. Lee	234	Superintendent Class L	32 90	
Sept. 24	D. Davis & Son	235	Premium		30 00
Sept. 24	E. J. Pease	236	Judge Class L	12 00	
Sept. 24	C. E. Hinman	237	Judge Class L	12 00	
Sept. 24	J. H. Davis	238	Judge on corn	18 00	
Sept. 24	C. B. McCorkle	239	Judge Class F	15 75	
Sept. 24	Mrs. J. J. Bryant	240	Judge Class G	24 00	
Sept. 24	E. B. Mitchell & Son	241	Premiums		50 00
Sept. 24	Risk & Gabbert	242	Premiums		40 00
Sept. 24	J. S. Magers	243	Premiums		40 00
Sept. 24	W. L. DeClow	244	Premiums		15 00
Sept. 24	J. B. Thompson	245	Premiums		70 00
Sept. 24	L. B. Goodrich	246	Premiums		15 00
Sept. 24	C. F. Stone	247	Premiums		52 00
Sept. 24	J. E. Miller	248	Premiums		50 00
Sept. 24	Smith & Shinn	249	Premiums		5 00
Sept. 24	S. M. Nelson	250	Clerk corn show	3 00	
Sept. 24	S. M. Nelson	251	Clerk Class F	3 00	
Sept. 24	L. Morse	252	Judge	20 00	
Sept. 24	L. A. Kent	253	Judge	5 00	
Sept. 24	L. A. Kent	254	Clerk	9 00	
Sept. 24	J. D. Ream	255	Superintendent Class O	26 50	
Sept. 24	Sol. Netzner	256	Clerk to Secretary	12 00	

Digitized by Google

LIST OF WARRANTS, 1897—*Continued.*

DATE.	TO WHOM ISSUED.	NO.	FOR WHAT PURPOSE.	MISC.	PREM.
Sept. 24	E. McIntyre, treas.	257	Refund	8 00	
Sept. 24	E. B. Reynolds & Son	258	Switching	3 00	
Sept 24	Reuben Gentry	259	Premium		50 00
Sept. 24	D. B. Jones	260	Premium		25 00
Sept. 24	E. M. Searle	261	Pay roll	230 00	
Sept. 24	E. Wyman	262	Judge Class O	17 60	
Sept. 24	O. G. Smith	263	Superintendent Class M	55 70	
Sept. 24	I. W. Chappell	264	Premiums		45 00
Sept. 24	Frank Iams	265	Premiums		100 00
Sept. 24	Geo. Pace	266	Pay roll	300 00	
Sept. 24	Chas. Fordyce	267	Superintendent Class I	45 32	
Sept. 24	G. D. McClasky	268	Judge pigeons	1 00	
Sept. 24	Lafe Myers	269	Special detective	20 00	
Sept. 24	C. D. DeLorme	270	Horse and buggy	13 00	
Sept. 25	Slayton Jub. Singers	271	Balance account	150 00	
Sept. 25	L. R. Fletcher	272	Judge Class F	15 50	
Sept. 25	W. E. Hatch	273	Clerk to Secretary	21 00	
Sept. 25	L. A. Becher	274	Superintendent Class F	37 60	
Sept. 25	W. H. Harrison	275	Pay roll	75 00	
Sept. 25	A. B. Bassett	276	Superintendent ice water	25 50	
Sept. 25	D. T. Mount	277	Pay roll	165 56	
Sept. 25	C. M. Lewelling	278	Superintendent Class E	45 00	
Sept. 25	Jesse Lewis	279	Assistant superintendent Class E	31 75	
Sept. 25	E. H. Eggert	280	Labor poultry department	13 50	
Sept. 24	C. M. Lewelling	281	Railroad fare, etc	9 07	
Sept. 24	H. P. Deuel	282	Assistant Supt. Amphitheatre	10 00	
Sept. 24	Chas. Mann	283	Judge	25 00	
Sept. 24	The World Pub. Co.	284	Advertising	40 00	
Sept. 24	McCook Band	285	Music	375 00	
Sept. 24	T. W. Compton	286	Hostler	18 00	
Sept. 24	Geo. Pace	287	Police pay roll	365 00	
Sept. 24	A. P. Job	288	Judge Class F	15 50	
Sept. 24	Harney St. Stables	289	Horse and buggy	20 00	
Sept. 24	E. M. Searle	290	Superintendent gates	75 00	
Sept. 24	E. M. Searle	291	Pay roll	21 00	
Sept. 24	E. M. Searle	292	Refund	4 10	
Sept. 24	W. A. McKey	293	Refund	2 00	
Sept. 24	M. Doolittle	294	Special detective	80 00	
Sept. 24	M. Doolittle	295	Expenses	11 30	
Sept. 24	M. Doolittle	296	Supplies	2 45	
Sept. 24	Miller & Beswick	297	Use of Reg. gates	100 00	
Sept. 24	W. H. Barger	298	Superintendent Class C	57 50	
Sept. 24	J. A. Ayers	299	Assistant Supt. Class C	25 04	
Sept. 24	Buffalo Co. Beacon	300	Printing	14 50	
Sept. 26	John Pfiefer	301	Speed		55 00
Sept. 26	John Pfiefer	302	Speed		5 00
Sept. 21	H. D. Bennett	303	Speed		135 00
Sept. 21	H. D. Bennett	304	Speed		15 00
Sept. 21	Kelley & Bibbins	305	Speed		66 65
Sept. 21	Kelley & Bibbins	306	Speed		24 99
Sept. 21	E. E. Faulkner	307	Speed		73 32
Sept. 21	E. E. Faulkner	308	Speed		13 34
Sept. 21	D. Ensinger	309	Speed		180 00
Sept. 21	D. Ensinger	310	Speed		20 00
Sept. 21	G. W. Buracher	311	Speed		13 34
Sept. 20	G. W. Buracher	312	Speed		13 34
Sept. 20		313	Void		
Sept. 20		314	Void		
Sept. 20	Mrs. Emma Pickard	315	Speed		10 33
Sept. 20	Mrs. Emma Pickard	316	Speed		9 67
Sept. 20	E. K. Kentner	317	Speed		225 00
Sept. 20	E. K. Kentner	318	Speed		25 00
Sept. 20	O. A. Kentner	319	Speed		80 00
Sept. 20	O. A. Kentner	320	Speed		20 00
Sept. 20	C. B. Johnson	321	Speed		10 00
Sept. 20	C. B. Johnson	322	Speed		5 00
Sept. 20	O. Hall	323	Speed		10 00
Sept. 20	O. Hall	324	Speed		5 00
Sept. 22	O. B. Hillis	325	Speed		60 00
Sept. 22	O. B. Hillis	326	Speed		20 00

Digitized by Google

LIST OF WARRANTS, 1897—*Continued.*

DATE.	TO WHOM ISSUED.	NO.	FOR WHAT PURPOSE.	MISC.	PREM.
Sept. 22	H. M.Spencer	327	Speed		70 00
Sept. 22	H. M. Spencer	328	Speed		30 00
Sept. 22	C. M. Kelley	329	Speed		183 32
Sept. 22	C. M. Kelley	330	Speed		25 00
Sept. 22	C. V. Townley	331	Speed		50 00
Sept. 22	C. V. Townley	332	Speed		25 00
Sept. 22	John McGuire	333	Speed		121 65
Sept. 22	John McGuire	334	Speed		65 00
Sept. 22	Hoop Parry	335	Speed		100 00
Sept. 22	Hoop Parry	336	Speed		20 00
Sept. 23	George Garrett	337	Speed		55 00
Sept. 23	George Garrett	338	Speed		5 00
Sept. 23	C. W. Schanno	339	Speed		20 00
Sept. 23	C. W. Schanno	340	Speed		5 00
Sept. 23	John Pfiefer	341	Speed		55 00
Sept. 23	John Pfiefer	342	Speed		5 00
Sept. 23	O. Hall	343	Speed		10 00
Sept. 23	O. Hall	344	Speed		5 00
Sept. 23	G. F. McKinney	345	Speed		80 00
Sept. 23	G. F. McKinney	346	Speed		30 00
Sept. 23	C. O. Tapp	347	Speed		79 83
Sept. 23	C. O. Tapp	348	Speed		11 83
Sept. 23	H. B. Watson	349	Speed		50 00
Sept. 23	H. B. Watson	350	Speed		25 00
Sept. 23	C. L. Garrison	351	Speed		158 32
Sept. 23	C. L. Garrison	352	Speed		25 00
Sept. 23	J. W. Smith	353	Speed		270 00
Sept. 23	J. W. Smith	354	Speed		30 00
Sept. 23	A. G. Friez	355	Speed		24 99
Sept. 23	A. G. Friez	356	Speed		16 66
Sept. 23	Woodline Farm	357	Speed		152 99
Sept. 23	Woodline Farm	358	Speed		175 35
Sept. 24	George Garrett	359	Speed		20 00
Sept. 24	George Garrett	360	Speed		5 00
Sept. 24		361	Speed		
Sept. 24	John Keating	362	Speed		25 00
Sept. 24	D. Ensininger	363	Speed		58 31
Sept. 24	D. Ensininger	364	Speed		25 00
Sept. 24	John Keating	365	Speed		74 98
Sept. 24	T J. Bocock	366	Speed		63 31
Sept. 24	T. J. Bocock	367	Speed		130 00
Sept. 24	J. Hileman	368	Speed		176 00
Sept. 24	J. Hileman	369	Speed		74 00
Sept. 24	C. W. Schanno	370	Speed		10 00
Sept. 24	C. W. Schanno	371	Speed		5 00
Sept. 24	T. J. Bocock	372	Speed		20 00
Sept. 24	William Day	373	Speed		55 00
Sept. 24	William Day	374	Speed		5 00
Sept. 24	L. Starcher	375	Speed		20 00
Sept. 24	L. Starcher	376	Speed		5 00
Sept. 24	John Gahan	377	Speed		15 00
Sept. 24	John Gahan	378	Speed		10 00
Sept. 24	J. N. McChillan	379	Speed		116 65
Sept. 24	J. N. McChillan	380	Speed		25 00
Sept. 24	J. P. Elmore	381	Speed		26 31
Sept. 24	J. P. Elmore	382	Speed		67 00
Sept 24	J. N. Kay	383	Speed		40 00
Sept. 24	J. N. Kay	384	Speed		13 34
Sept. 24	Jack Curry	385	Speed		120 66
Sept. 24	Jack Curry	386	Speed		46 00
Sept. 24	James C. Wallace	387	Speed		405 00
Sept. 24	J. D. Yeoman	388	Speed		16 66
Sept. 24	James C. Wallace	389	Speed		45 00
Sept. 24	J. D. Yeoman	390	Speed		8 33
Sept. 24	Al. Russell	391	Speed		20 00
Sept. 24	Bud Lalla	392	Speed		16 66
Sept. 24	Bud Lalla	393	Speed		16 66
Sept. 24	W. A. Paxton, Jr.	394	Speed		108 34
Sept. 24	W. A. Paxton, Jr.	395	Speed		145 00
Sept. 24	Ed Pyle	396	Speed		46 67

Digitized by Google

LIST OF WARRANTS, 1897—*Continued.*

DATE.	TO WHOM ISSUED.	NO.	FOR WHAT PURPOSE	MISC.	PREM.
Sept. 24	Ed Pyle	397	Speed		20 00
Sept. 24	Jack Curry	398	Speed		66 68
Sept. 24	Jack Curry	399	Speed		20 00
Sept. 24	J. W. Harkins	400	Speed		73 32
Sept. 24	J. W. Harkins	401	Speed		20 00
Sept. 24	C. Rissi	402	Speed		20 00
Sept. 24	C. Rissi	403	Speed		13 33
Sept. 24	Al. Russell	404	Speed		108 33
Sept. 24	Al. Russell	405	Speed		41 67
Sept. 24	V. Maulsby	406	Speed		13 33
Sept. 24	V. Maulsby	407	Speed		6 67
Sept. 24	John Pfiefer	408	Speed		55 00
Sept. 24	John Pfiefer	409	Speed		5 00
Sept. 24	John Gehan	410	Speed		5 00
Sept. 24	John Gehan	411	Speed		20 00
Sept. 24	C. E. Holland	412	Speed		6 67
Sept. 24	C. E. Holland	413	Speed		6 67
Sept. 24	M. C. Keith	414	Speed		33 33
Sept. 24	D. T. Mount	415	Speed		78 33
Sept. 24	C. E. Morse	416	Speed		140 67
Sept. 24	C. E. Morse	417	Speed		159 00
Sept. 24	O. Hall	418	Speed		10 00
Sept. 24	O. Hall	419	Speed		5 00
Sept. 25	Ida B. Humphrey	420	Expert judge	41 37	
Sept. 25	W. E. Dilrance	421	Livery	23 00	
Sept. 25	J. L. Todd	422	Premium		25 00
Sept. 25	E. E. Smith	423	Judge Class F	9 00	
Sept. 25	H. D. Kelley	424	Supt. Manufacturing Hall	45 00	
Sept. 25	Jud. Holcomb	425	Superintendent Class D	50 00	
Sept. 25	W. H. Harrison	426	General Superintendent	79 40	
Sept. 25	Elijah Filley	427	Superintendent Class B	45 00	
Sept. 25	C. A. Dunham	428	Booth manager	350 25	
Sept. 25	W. D. Mann	429	Pay roll	240 00	
Sept. 25	Geoge F. Dickman	430	Speed clerk	66 00	
Sept. 25	P. Youngers, Treas.	431	Appropriation	800 00	
Sept. 25	N. Withrow	432	Superintendent Class A	48 79	
Sept. 25	Alice Macomber	433	Clerk to Secretary	51 00	
Sept. 25	Bertha Macomber	434	Clerk to Secretary	48 00	
Sept. 25	John Saunders	435	Janitor	18 00	
Sept. 25	Ed Ewan	436	Clerk to Secretary	21 00	
Sept. 25	G. W. Fairbrother	437	Clerk to Secretary	3 00	
Sept. 25	Josie McDermott	438	Stenographer	30 00	
Sept. 25	Paul Covert	439	Messenger	17 00	
Sept. 25	B. F. Prince	440	Supt. transportation	75 00	
Sept. 25	E. E. Bruce & Co.	441	Tickets returned	19 50	
Sept. 25	E. L. Vance	442	Advertising	51 25	
Sept. 25	E. L. Vance	443	Expense to Des Moines	5 35	
Sept. 25	B. R. Stouffer	444	Superintendent Class I	31 00	
Sept. 25	George Pace	445	Chief of Police	83 35	
Sept. 25	W. L. May	446	Superintendent Fish	25 00	
Sept. 25	Nebraska Fish Com.	447	Expense of exhibit	150 00	
Sept. 25	Robert W. Furnas	448	Expense of exhibit	19 20	
Sept. 25	Rees Printing Co.	449	Printing	668 00	
Sept. 25	O C. Williams	450	Advertising	45 83	
Sept. 25	M. Dunham	451	Superintendent drays, etc.	55 00	
Sept. 25	M. E. Dodson	452	Drayage	27 00	
Sept. 25	F. P. Day	453	Superintendent Art Hall	97 10	
Sept. 27	Mrs. M. M. Presson	454	Superintendent Textile Hall	48 20	
Sept. 27	Grace Britt	455	Clerk Textile Hall	7 50	
Sept. 27	Mable Britt	456	Clerk Textile Hall	3 00	
Sept. 27	E. McIntyre, Treas.	457	Interest	96 46	
Sept. 27	J. H. Butler	458	Superintendent forage	60 00	
Sept. 27	James Boileau & Sons	459	Premiums		13 00
Sept. 27	George G. Furnas	460	Assistant to Secretary	105 00	
Sept. 27	Harry M. Shaeffer	461	Assistant to Secretary	105 00	
Sept. 27	O. C. Williams	462	Clerk to board	58 00	
Sept. 27	Charles C. Hungate	463	Clerk to President	32 00	
Sept. 27	M. Z. Forscutt	464	Clerk to President	9 00	
Sept. 27	J. B. Dinsmore	465	Expense	11 41	
Sept. 27	J. B. Dinsmore	466	Salary	250 00	

Digitized by Google

LIST OF WARRANTS, 1897—*Continued.*

DATE.	TO WHOM ISSUED.	NO.	FOR WHAT PURPOSE.	MISC.	PREM.
Sept. 27	E. L. Vance	467	Salary	187 50	
Sept. 27	S. C. Bassett	468	Salary	187 50	
Sept. 27	W. A. Poynter	469	Salary	187 50	
Sept. 27	E. A. Barnes	470	Salary	187 50	
Sept. 27	Receiver U. P. Ry	471	Switching and freight	89 44	
Sept. 27	Kimball Ice Co	472	Ice	46 03	
Sept. 27	Whitmore Bros	473	Hay, etc	105 98	
Sept. 27	Kansas Farmer	474	Advertising	10 00	
Sept. 27	H. L. Brandes	475	Advertising	10 10	
Sept. 27	Lincoln Transfer Co	476	Freight and drayage	1 60	
Sept. 27	H. Jeger	477	Judge Class O	14 00	
Sept. 27	Den Danske. pioneer.	478	Advertising	10 00	
Sept. 27	Neb. State Journal	479	Advertising	40 00	
Sept. 27	Nebraska Farmer Co.	480	Advertising	25 00	
Sept. 27	M. W. Neihart	481	Advertising	60 00	
Sept. 27	J. G. P. Hildebrand	482	Advertising	10 00	
Sept. 27	J. R. Cantlin	483	Superintendent Class F	27 05	
Sept. 27	Mrs. R. C. Hayes	484	Superintendent Class I	24 00	
Sept. 27	Lincoln Hotel	485	Hotel bills	73 50	
Sept. 27	C. C. Pace	486	Advertising	8 00	
Sept. 27	W. T. Horne	487	Examining grasses	11 40	
Sept. 27	J. A. Warren	488	Examining grasses	11 80	
Sept. 27	W. R. Jackson	489	Judge Class J	5 00	
Sept. 27	Omaha Van & Stor. Co.	490	Moving office	5 00	
Sept. 27	Omaha Pub. Co	491	Advertising	9 00	
Sept. 27	Clem Chase	492	Supplies	2 60	
Sept. 27	Clem Chase	493	Supplies	7 55	
Sept. 27	Clem Chase	494	Supplies	1 30	
Sept. 27	J. P. Cooke & Co	495	Rubber stamps	9 92	
Sept. 27	M. E. Mulvahill	496	Advertising	14 05	
Sept. 27	The Cultivator	497	Advertising	10 00	
Sept. 27	F. F. Roose	498	Writing diplomas	8 25	
Sept. 27	West'n Union Tel. Co.	499	Telegrams	7 44	
Sept. 27	D. T. Mount	500	Sprinklers, etc	215 59	
Sept. 27	E. McIntyre	501	Salary	250 00	
Sept. 27	Fairbanks, Morse & Co	502	Labor water department	33 00	
Sept. 27	B. & M. Railroad Co.	503	Freight on sawdust	22 68	
Sept. 27	S. C. Bassett	504	Expenses	12 00	
Sept. 27	E. A. Barnes	505	Expenses to Minnesota	25 00	
Sept. 27	W. D. Mann	506	Pay roll	75 00	
Sept. 27	G. W. Hervey	507	Merchandise	9 18	
Sept. 27	N. Withrow	508	Filling dirt in barn	1 50	
Sept. 27	Missouri Pacific Ry	509	Switching	12 00	
Sept. 27	M. Doolittle	510	Salary	300 00	
Sept. 27	Millard Hotel	511	Hotel bill	475 10	
Sept. 30	J. H. Steiner	512	Speed penalties collected	407 50	
Oct. 1	Robert W. Furnas	513	Salary and allowance September	216 00	
Oct. 1	Austin Humphrey	514	Superintendent Amphitheatre	25 00	
Oct. 1	A. C Jones	515	Superintendent Agricultural Hall	40 00	
Oct. 1	Ed. Whitcomb	516	Superintendent Class K	40 00	
Oct. 1	J. H. Fawell	517	Assistant to Treasurer	10 00	
Oct. 1	J. N. VanDuyn	518	Advertising	6 50	
Oct. 1	Lloyd Royse	519	Postage for September	11 66	
Oct. 4	J. B. Lewis	520	Ft., Tel. & Express, September	16 37	
Oct. 5	J. P. Cooke & Co	521	Rubber stamp	5 12	
Oct. 11	B. & M. Railroad Co.	522	Switching	42 00	
Oct. 26	Mrs. W. C Crooks	523	Premiums		1 65
Oct. 26	Miss Mary Cahell	524	Premiums		55
Oct. 26	Miss Anna Chase	525	Premiums		1 10
Oct. 26	Margaret B. Cooke	526	Premiums		1 92
Oct. 26	Mrs. Clara Cutler	527	Premiums		27
Oct. 26	Misses Clark & Wetzel	528	Premiums		1 65
Oct. 26	Mrs. C. J. Crooks	529	Premiums		6 60
Oct. 26	Mrs. J. E. Cramer	530	Premiums		3 30
Oct. 26	Mrs. A. T. Carter	531	Premiums		2 20
Oct. 26	Ada M. Conoway	532	Premiums		55
Oct. 26	Mrs. J. L. Caldwell	533	Premiums		1 10
Oct. 26	Caledonia Cream. Co.	534	Premiums		6 02
Oct. 26	Cuming Co. Ag. Soc.	535	Premium and switching		95 06
Oct. 26	W. L. DeClow	536	Premium and switching		11 08

Digitized by Google

LIST OF WARRANTS, 1897—*Continued.*

DATE.	TO WHOM ISSUED.	NO.	FOR WHAT PURPOSE.	MISC.	PREM.
Oct. 26	D. Davis & Son	537	Premium and switching		17 30
Oct. 26	Davison & Chryster	538	Premium		2 20
Oct. 26	Dawson Bros. & Co	539	Premium and switching		42 60
Oct. 26	Casper Dice	540	Premiums		8 58
Oct. 26	Aug. Davidson	541	Premiums		19 08
Oct. 26	C. E. Drake	542	Premiums		4 07
Oct. 26	S. Davis	543	Premiums		1 10
Oct. 26	A. K. Dinge	544	Premiums		1 32
Oct. 26	O. Denkins	545	Premiums		1 65
Oct. 26	J. W. Dilen	546	Premiums		1 10
Oct. 26	J. Drummond	547	Premiums		6 05
Oct. 26	C. C. Devo	548	Premiums		1 10
Oct. 26	John Dorritty	549	Premiums		2 20
Oct. 26	Mrs. G. H. Devereaux	550	Premiums		1 92
Oct. 26	Mrs. G. B. Dake	551	Premiums		55
Oct. 26	Mrs. G. A. Diels	552	Premiums		1 87
Oct. 26	Mrs. H. L. Day	553	Premiums		1 87
Oct. 26	Mrs. D. J. Dodson	554	Premiums		55
Oct. 26	Mrs. A. M. Darling	555	Premiums		2 75
Oct. 26	Mrs O. W. Davenport	556	Premiums		55
Oct. 26	Nora Daugherty	557	Premiums		55
Oct. 26	Mrs. E. Dailey	558	Premiums		55
Oct. 26	Mrs. C. W. Downs	559	Premiums		4 62
Oct. 26	R. W. Douglas	560	Premiums		3 96
Oct. 26	Mrs. J. B. Drummon	561	Premiums		2 20
Oct. 26	Arthur Dirkson	562	Premiums		1 10
Oct. 26	Dundy Co. Agr. Soc	563	Premiums		54 93
Oct. 26	Dawes Co. Agr. Soc	564	Premiums		45 93
Oct. 26	Dawson Co. Agr. Soc	565	Premiums		44 21
Oct. 26	J. C. Edwards	566	Premiums		6 60
Oct. 26	C. H. Elmendorf	567	Premiums		29 70
Oct. 26	E. H. Eggert	568	Premiums		22 27
Oct. 26	F. P. Engleman	569	Premiums		27
Oct. 26	Wm. Ellsworth	570	Premiums		1 32
Oct. 26	Minnie M. Ellis	571	Premiums		2 75
Oct. 26	Mrs. F. W. Emerson	572	Premiums		6 65
Oct. 26	G. E. Edlund	573	Premiums		1 10
Oct. 26	D. Fisher	574	Premiums		2 64
Oct. 26	Thos. Foster	575	Premiums		5 28
Oct. 26	L. S. Frantz	576	Premiums		1 65
Oct. 26	L. Fester	577	Premiums		1 32
Oct. 26	Wm. Finney	578	Premiums		1 65
Oct. 26	Albert Funks	579	Premiums		55
Oct. 26	Mrs. J. B. Ferguson	580	Premiums		1 32
Oct. 26	Mary France	581	Premiums		55
Oct. 26	Mary Fassett	582	Premiums		27
Oct. 26	Mrs. J. W. Fead	583	Premiums		2 15
Oct. 26	Mrs. Thos. Furgeson	584	Premiums		82
Oct. 26	Belle Finley	585	Premiums		55
Oct. 26	Mrs. M. H. Ford	586	Premiums		17 76
Oct. 26	Alice Furay	587	Premiums		2 86
Oct. 26	Walter Fischel	588	Premiums		1 10
Oct. 26	Mrs. R. D. Fitch	589	Premiums		3 30
Oct. 26	Mabel Fairchild	590	Premiums		55
Oct. 26	Connie J. Furay	591	Premiums		2 75
Oct. 26	Claud Fordyce	592	Premiums		2 20
Oct. 26	Furnas Co. Agr. Soc	593	Premiums		62 59
Oct. 26	Fillmore Co. Agr. Soc.	594	Premium and switching		64 24
Oct. 26	Frontier Co. Agr. Soc.	595	Premium and switching		49 32
Oct. 26	C. F. Gollehorn	596	Premiums		8 80
Oct. 26	L. B. Goodrich	597	Premiums		15 95
Oct. 26	E. M. Gibson	598	Premiums		2 20
Oct. 26	Henry Glissman	599	Premiums		5 28
Oct. 26	W. A. Gronaweg	600	Premiums		6 60
Oct. 26	C. T. Graves	601	Premiums		68 75
Oct. 26	H. C. Glissman & Son	602	Premiums		9 02
Oct. 26	Reuben Gentry	603	Premium and switching		19 06
Oct. 26	W. M. Gilmore & Son	604	Premiums		21 56
Oct. 26	O. E. Gaines	605	Premiums		2 15
Oct. 26	Dr. O. Gaiser	606	Premiums		7 92

Digitized by Google

LIST OF WARRANTS, 1897—*Continued.*

DATE.	TO WHOM ISSUED.	NO.	FOR WHAT PURPOSE.	MISC.	PREM.
Oct. 26	W. G. Gooden	607	Premiums		82
Oct. 26	S. J. Garoutte	608	Premiums		2 64
Oct. 26	S. J. Gadd	609	Premiums		6 71
Oct. 26	Chas. Gran	610	Premiums		8 91
Oct. 26	R. Grooms	611	Premiums		1 10
Oct. 26	Mrs. F. E. Gage	612	Premiums		11 82
Oct. 26	Mrs. A. G. Greenlee	613	Premiums		946
Oct. 26	Harriet Goss	614	Premiums		110
Oct. 26	Mrs. J. E. Gardiner	615	Premiums		55
Oct. 26	Mary E. Gratton	616	Premiums		55
Oct. 26	Robt. F. Gilder	617	Premiums		3 52
Oct. 26	Jennie L. Grover	618	Premiums		1 65
Oct. 26	Margeritte Gentzke	619	Premiums		55
Oct. 26	Gage Co. Agr. Soc	620	Premium andswitchi ng		65 40
Oct. 26	J. M. Harrison	621	Premium and switching		15 32
Oct. 26	O. H. Hillis	622	Premiums		3 08
Oct. 26	W. S. Harris	623	Premiums		5 28
Oct. 26	O. P. Hendershot	624	Premiums		3 08
Oct. 26	W. H. Heil & Bro	625	Premiums		70 44
Oct. 26	Hudson & Foster	626	Premiums		18 10
Oct. 26	E. R. Hitchcock	627	Premium and switching		8 28
Oct. 26	Jos Hynek & Son	628	Premium and switching		6 52
Oct. 26	Jacob Hetrick	629	Premiums		3 46
Oct. 26	H. W. Hewitt	630	Premiums		82
Oct. 26	W. S. Hillis	631	Premiums		82
Oct. 26	F. C. Hinman	632	Premiums		3 46
Oct. 26	L. P. Harris	633	Premiums		7 42
Oct. 26	E. L. Houtz	634	Premiums		2 97
Oct. 26	E. Hays	635	Premiums		6 82
Oct. 26	O. P. Hendershott	636	Premiums		7 70
Oct. 26	J. W. Hawkins	637	Premiums		1 32
Oct. 26	Henry Hadley	638	Premiums		55
Oct. 26	John Havens	639	Premiums		55
Oct. 26	Oscar G. Houck	640	Premiums		1 10
Oct. 26	Anna M. Harris	641	Premiums		9 35
Oct. 26	Anna Hudson	642	Premiums		2 15
Oct. 26	Mrs. E. C. Hill	643	Premiums		7 42
Oct. 26	Mrs. L. Hirsch	644	Premiums		4 95
Oct. 26	Mary E. Hayes	645	Premiums		3 30
Oct. 26	Dora Harney	646	Premiums		1 32
Oct. 26	Mrs. Geo. Hendee	647	Premiums		82
Oct. 26	Lou Houchin	648	Premiums		55
Oct. 26	A. Hospe	649	Premiums		2 20
Oct. 26	Louise S. Hobbie	650	Premiums		1 76
Oct. 26	Heyn The Photog'r	651	Premiums		1 10
Oct. 26	Hadley & Place	652	Premiums		2 47
Oct. 26	A. F. Hartwell	653	Premiums		2 97
Oct. 26	Mrs. J. W. Hood	654	Premiums		55
Oct. 26	Mrs. R. H. Howard	655	Premiums		1 10
Oct. 26	Eva Howard	656	Premiums		1 10
Oct. 26	Chas. Hogle	657	Premiums		3 52
Oct. 26	Frank Iams	658	Premiums		33 20
Oct. 26	W. A. Irwin	659	Premiums		6 93
Oct. 26	Harry Johnson	660	Premiums		26 18
Oct. 26	D. B. Jones	661	Premiums		24 10
Oct. 26	J. Cook Johnson	662	Premiums		1 32
Oct. 26	Mark Jewett	663	Premiums		1 10
Oct. 26	E. D. Johnson	664	Premiums		18 85
Oct. 26	Wm. James	665	Premiums		6 50
Oct. 26	Nels Johnson	666	Premiums		55
Oct. 26	Margaret Jackson	667	Premiums		5 65
Oct. 26	Mrs. Emma James	668	Premiums		27
Oct. 26	Mrs. H. C. Johnson	669	Premiums		55
Oct. 26	Mrs. H. A. Johnson	670	Premiums		1 65
Oct. 26	Gertrude Johnson	671	Premiums		55
Oct. 26	Hannah B. Johnson	672	Premiums		82
Oct. 26	Mrs. H. Jensen	673	Premiums		1 10
Oct. 26	Lillie Jonasen	674	Premiums		1 10
Oct. 26	Mrs. L. Jensen	675	Premiums		5 28
Oct. 26	Mrs. C. Juleson	676	Premiums		55

Digitized by Google

LIST OF WARRANTS, 1897—*Continued.*

DATE.	TO WHOM ISSUED.	NO.	FOR WHAT PURPOSE.	MISC.	PREM.
Oct. 26	Mrs. J. M. Johnson	677	Premiums		55
Oct. 26	Keystone Stock Farm	678	Premiums		6 60
Oct. 26	John A. Kenny	679	Premiums		1 32
Oct. 26	Robt. Keel	680	Premiums		1 10
Oct. 26	W. H. Kelly	681	Premiums		55
Oct. 26	Mrs. J. F. King	682	Premiums		9 02
Oct. 26	Annie Kruse	683	Premiums		55
Oct. 26	Belle Keyser	684	Premiums		2 47
Oct. 26	Amy B. King	685	Premiums		1 10
Oct. 26	Fred B. Knight	686	Premiums		3 52
Oct. 26	Winifred Kimball	687	Premiums		1 32
Oct. 26	Wilber F. King	688	Premiums		2 00
Oct. 26	J. J. King	689	Premiums		7 65
Oct. 26	E. Kretchmer	690	Premiums		41 90
Oct. 26	Ray Kretchmer	691	Premiums		3 75
Oct. 26	Kearney Co. Agr. Soc.	692	Premium and switching		52 43
Oct. 26	Knox Co. Agr. Soc.	693	Premium		38 47
Oct. 26	J. J. Lightbody	694	Premium and switching		8 28
Oct. 26	J. W. Lash	695	Premium		11 88
Oct. 26	Mrs. A. B. Lathrop	696	Premium		11 50
Oct. 26	H. B. Louden & Son	697	Premium and switching		5 20
Oct. 26	P. R. Longfellow	698	Premiums		3 80
Oct. 26	A. Lemen	699	Premiums		9 07
Oct. 26	O. H. Luts	700	Premiums		9 02
Oct. 26	D. M. Lewis	701	Premiums		1 32
Oct. 26	David Larson	702	Premiums		6 60
Oct. 26	R. D. Leard	703	Premiums		5 28
Oct. 26	E. F. Lehman	704	Premiums		2 20
Oct. 26	M. W. Lilley	705	Premiums		1 32
Oct. 26	Peter Larsen	706	Premiums		1 32
Oct. 26	Henry Lamb	707	Premiums		2 15
Oct. 26	Mrs. G. B. Lathrop	708	Premiums		55
Oct. 26	Mrs. Frances Lehman	709	Premiums		1 32
Oct. 26	Mrs. J. B. Lewis	710	Premiums		1 10
Oct. 26	Mrs. C. E. Leslie	711	Premiums		1 87
Oct. 26	Orson Lowell	712	Premiums		7 04
Oct. 26	Margaret Livingston	713	Premiums		2 42
Oct. 26	Mrs. S. G. Lund	714	Premiums		1 10
Oct. 26	W. W. Ladd	715	Premiums		6 50
Oct. 26	Lovesy & Bouck	716	Premiums		3 30
Oct. 26	R. M. Lewis, Mrs	717	Premiums		3 52
Oct. 26	C. M. Lewelling	718	Premiums		4 40
Oct. 26	J. E. Miller	719	Premiums		6 00
Oct. 26	J. E. Miller	720	Premiums		17 52
Oct. 26	J. H. McCordle	721	Premiums		5 28
Oct. 26	D. T. Mount	722	Premiums		23 32
Oct. 26	J. H. McAllister	723	Premiums		80 52
Oct. 26	E. B. Mitchell & Son	724	Premium and switching		26 98
Oct. 26	W. A. McHenry	725	Premium		57 20
Oct. 26	W. Guy McCandless	726	Premium		26 62
Oct. 26	Mrs. Guy McCandless	727	Premium		82
Oct. 26	L. E. Mahan & Co	728	Premium and switching		99 03
Oct. 26	C. M. Morton	729	Premium		4 40
Oct. 26	W. H. McCall	730	Premium and switching		83 96
Oct. 26	Meissner Bros	731	Premium and switching		15 32
Oct. 27	Sam McKelvie	732	Premium		10 55
Oct. 27	J. Mandelbaum	733	Premium		16 28
Oct. 27	J. S. Magers	734	Premium		2 64
Oct. 27	Geo. McKerrow	735	Premium and switching		70 32
Oct. 27	E. W. Martin	736	Premiums		3 45
Oct. 27	W. A. Melson	737	Premiums		6 43
Oct. 27	Geo. O. Monroe	738	Premiums		1 65
Oct. 27	Willis Mumaugh	739	Premiums		82
Oct. 27	Lewis Mener	740	Premiums		1 32
Oct. 27	W. A. McCool	741	Premiums		11 38
Oct. 27	P. Murphy	742	Premiums		2 20
Oct. 27	J. S. McMinn	743	Premium and switching		16 10
Oct. 27	F. Mauer	744	Premiums		82
Oct. 27	E. Marsh	745	Premiums		82
Oct. 27	B. F. Muman	746	Premiums		3 45

Digitized by Google

LIST OF WARRANTS, 1887—*Continued.*

DATE.	TO WHOM ISSUED.	NO.	FOR WHAT PURPOSE.	MISC.	PREM.
Oct. 27	John Mahatt	747	Premiums		2 20
Oct. 27	H. Miller	748	Premiums		1 10
Oct. 27	Mrs. I. J. McDonald	749	Premiums		6 32
Oct. 27	Mrs. M. McLane	750	Premiums		7 05
Oct. 27	Mrs. A. W. McLaughlin	751	Premiums		7 42
Oct. 27	Mrs. C. A. Mansfield	752	Premiums		55
Oct. 27	Mrs. W. R. Morand	753	Premiums		1 37
Oct. 27	Mrs. L. F. Maguin	754	Premiums		55
Oct. 27	Miss Monnell	7 5	Premiums		2 15
Oct. 27	Mae McKenzie	756	Premiums		1 10
Oct. 27	Mrs. C. Meiclure	757	Premiums		1 10
Oct. 27	Mrs. Robt. McPhers'n	758	Premiums		4 07
Oct. 27	Mrs. H. S. Murdock	759	Premiums		16 22
Oct. 27	Mrs. G. Morgan	760	Premiums		1 10
Oct. 27	Mrs. T. Mittauer	761	Premiums		2 75
Oct. 27	Mrs. M. G. McCague	762	Premiums		55
Oct. 27	Mrs. Richard Morrell	763	Premiums		1 75
Oct. 27	Mrs. R. A. McLoskey	764	Premiums		1 10
Oct. 27	Mrs. R. A. McEachron	765	Premiums		1 10
Oct. 27	Mrs. E. MacMillan	766	Premiums		1 65
Oct. 27	Ada E. Maginn	767	Premiums		55
Oct. 27	Cynthia M. McCague	768	Premiums		1 37
Oct. 27	Mary Murray	769	Premiums		1 10
Oct. 27	Merrick Co. Agr. Soc.	770	Premiums		88 28
Oct. 27	Alma B. Miekle	771	Premiums		5 72
Oct. 27	Mrs. J. C. Morrow	772	Premiums		18 53
Oct. 27	Mrs. M. F. Morrell	773	Premiums		25 92
Oct. 27	Mrs. E. Mun	774	Premiums		1 10
Oct. 27	M. H. Manley & Co	775	Premiums		3 63
Oct. 27	M. Ethel McKay	776	Premiums		55
Oct. 27	Mrs. G. Marty	777	Premiums		55
Oct. 27	M. E. Newburn	778	Premiums		104 64
Oct. 27	R. L. Newton	779	Premiums		6 10
Oct. 27	Nims Bros	780	Premiums		20 18
Oct. 27	Emma J. Nichol	781	Premiums		1 92
Oct. 27	Mrs. G. W. Nalle	782	Premiums		3 30
Oct. 27	Jas. Novacek	783	Premiums		1 92
Oct. 27	Al. A. P. Neville	784	Premiums		2 86
Oct. 27	Mrs. W. J. Nash	785	Premiums		2 75
Oct. 27	Nixon & Laughlin	786	Premiums		65 56
Oct. 27	Nuckolls Co. Agr. Soc.	787	Premiums		46 89
Oct. 27	Rollo Oliver	788	Premium and switching		37 76
Oct. 27	J. W. Oliver	789	Premiums		5 72
Oct. 27	J. Ockander	790	Premiums		1 65
Oct. 27	J. K. O'Neill	791	Premiums		3 08
Oct. 27	Mrs. T. M. Orr	792	Premiums		12 65
Oct. 27	A. E. Olander	793	Premiums		4 00
Oct. 27	H. J. Palmer	794	Premiums		11 00
Oct. 27	Mrs. Emma Pickard	795	Premiums		5 28
Oct. 27	Patrick Bros	796	Premiums		4 40
Oct. 27	Patrick Bros	797	Premiums		4 00
Oct. 27	E. A. Pegler	798	Premiums		8 75
Oct. 27	Frank Patton	799	Premiums		1 32
Oct. 27	Perkins Bros	800	Premiums		11 25
Oct. 27	I. Payne	801	Premiums		2 65
Oct. 27	Oscar Pflug	802	Premiums		2 20
Oct. 27	Geo. Pflug	803	Premiums		1 10
Oct. 27	John Pew	804	Premiums		10 17
Oct. 27	Cecil Pew	805	Premiums		10 00
Oct. 27	J. V. Porter	806	Premiums		1 32
Oct. 27	Frank Pign	807	Premiums		2 20
Oct. 27	Samuel Peterson	808	Premiums		1 32
Oct. 27	Frank Peterson	809	Premiums		5 65
Oct. 27	H. V. Persons	810	Premiums		3 55
Oct. 27	H. Peterson	811	Premiums		55
Oct. 27	Mary Peterson	812	Premiums		55
Oct. 27	Mrs. James Peterson	813	Premiums		3 80
Oct. 27	Mrs. M. A. Payner	814	Premiums		9 35
Oct. 27	Anna H. Partridge	815	Premiums		1 10
Oct. 27	Ethel H. Partridge	816	Premiums		55

Digitized by Google

LIST OF WARRANTS, 1897—*Continued.*

DATE.	TO WHOM ISSUED.	NO.	FOR WHAT PURPOSE.	MISC.	PREM.
Oct. 27	Ellen Parrish	817	Premiums		55
Oct. 27	Mrs. Eli Plummer	818	Premiums		1 92
Oct. 27	Mrs. W. C. Pritchard.	819	Premiums		1 37
Oct. 27	Mrs. Albert Parkins	820	Premiums		1 32
Oct. 27	Nellie J. Perfect	821	Premiums		55
Oct. 27	Mrs. E. R. Perfect	822	Premiums		2 42
Oct. 27	Charles G. Powell	823	Premiums		4 18
Oct. 27	L. Belle Perfect	824	Premiums		16 72
Oct. 27	Mrs. V. M. Barks	825	Premiums		4 62
Oct. 27	C. K. Poppleton	826	Premiums		2 20
Oct. 27	C. W. Poynter	827	Premiums		7 92
Oct. 27	Mrs. Mary Peterson	828	Premiums		1 10
Oct. 27	Maud Peterson	829	Premiums		1 10
Oct. 27	J. Prichard	830	Premiums		1 10
Oct. 27	Rhea Brothers	831	Premiums		3 62
Oct. 27	C. S. Rex	832	Premiums		6 60
Oct. 27	E. Reynolds & Son	833	Premium and switching		26 75
Oct. 27	Risk & Gabbert	834	Premium		4 40
Oct. 27	Wm. Roberts & Son	835	Premium and switching		77 80
Oct. 27	A. J. Richardson	836	Premium		27 72
Oct. 27	George Richardson	837	Premium and switching		24 78
Oct. 27	G. and D. J. Richards.	838	Premium		6 43
Oct. 27	Charles Ross	839	Premiums		3 96
Oct. 27	E G. Roberts & Co	840	Premiums		70 55
Oct. 27	Richard Ran	841	Premiums		1 65
Oct. 27	M. Robbins	842	Premiums		19 20
Oct. 27	Herman Roessig	843	Premiums		11 33
Oct. 27	Fred Rasch	844	Premiums		3 03
Oct. 27	T. O. Rich	845	Premiums		1 32
Oct. 27	George Ross	846	Premiums		1 92
Oct. 27	Thomas Reed	847	Premiums		55
Oct. 27	J. F. Rosenfield	848	Premiums		1 10
Oct. 27	W. Roza	849	Premiums		1 10
Oct. 27	J. A. Robeson	850	Premiums		6 05
Oct. 27	Martha Robbins	851	Premiums		2 20
Oct. 27	Mrs. M. J. Reed	852	Premiums		27
Oct. 27	Mrs. H. G. Rockfellow	853	Premiums		55
Oct. 27	Mrs. A. Root	854	Premiums		1 10
Oct. 27	Miss A. Rich	855	Premiums		55
Oct. 27	Mrs. W.B. Rutherford	856	Premiums		55
Oct. 27	Mrs. C. Reed	857	Premiums		2 75
Oct. 27	Mrs. R. J. Robeson	858	Premiums		1 92
Oct. 27	Blanche Roe	859	Premiums		1 65
Oct. 27	Charlotte Roe	860	Premiums		55
Oct. 27	Mrs. A. T. Rector	861	Premiums		3 96
Oct. 27	Mrs. C. U. Rose	862	Premiums		1 10
Oct. 27	Mrs. James A. Ryan	863	Premiums		1 65
Oct. 27	Raymond Creamery	864	Premiums		3 00
Oct. 27	Edith Robbins	865	Premiums		2 20
Oct. 27	Red Willow Co. Agr. Soc	866	Premiums		47 26
Oct. 27	A. L. Sullivan	867	Premiums		25 95
Oct. 27	W. H. Sylvester	868	Premiums		13 58
Oct. 27	S. W. Stewart	869	Premiums		7 05
Oct. 27	Stand. Trot. Horse Co.	870	Premiums		35 65
Oct. 27	E. N. Sherrill	871	Premiums		2 42
Oct. 27	E. N. Sherrill	872	Premiums		8 00
Oct. 27	Smith & Shinn	873	Premiums		1 65
Oct. 27	Stanton Breeding Co.	874	Premiums		61 15
Oct. 27	J. Stageman & Son	875	Premiums		8 80
Oct. 27	C. F. Stone	876	Premium and switching		11 80
Oct. 27	H. G. Sims	877	Premium		3 08
Oct. 27	W. Z. Swollow & Son.	878	Premium		3 52
Oct. 27	C. H. Searle	879	Premium and switching		40 85
Oct. 27	T. J. Shugart	880	Premiums		2 65
Oct. 27	E. O. Spencer	881	Premiums		4 30
Oct. 27	W. N. Smith	882	Premiums		1 32
Oct. 27	Southwick & Barclay.	883	Premiums		40 10
Oct. 27	John Skinner	884	Premiums		9 90
Oct. 27	Raymond Stryker	885	Premiums		2 97
Oct. 27	J. F. Schiffman	886	Premiums		5 28

Digitized by Google

LIST OF WARRANTS, 1897—*Continued.*

DATE.	TO WHOM ISSUED.	NO.	FOR WHAT PURPOSE.	MISC.	PREM.
Oct. 27	A. T. Stearns	887	Premiums		3 95
Oct. 27	C. M. Sanders	888	Premiums		3 45
Oct. 27	Fred Schoening	889	Premiums		3 30
Oct. 27	J. L. Shivers	890	Premiums		55
Oct. 27	Lee Smith	891	Premiums		23 75
Oct. 27	M. H. Smith	892	Premiums		6 60
Oct. 27	Jos. St. Louis	893	Premiums		1 10
Oct. 27	R. Struble	894	Premiums		1 32
Oct. 27	T. Sackett	895	Premiums		82
Oct. 27	B. F. Shultz	896	Premiums		2 20
Oct. 27	S. Spellman	897	Premiums		5 22
Oct. 27	Jay Stewart	898	Premiums		2 20
Oct. 27	N. Shafer	899	Premiums		82
Oct. 27	Adam Steinglein	900	Premiums		1 10
Oct. 27	S. E. Solomon	901	Premiums		1 10
Oct. 27	J. W. Shuman	902	Premiums		55
Oct. 27	G. Shrimpton & Son	903	Premiums		1 65
Oct. 27	Mrs. M. E. Shumway	904	Premiums		2 47
Oct. 27	Mrs. J. B. Shickley	905	Premiums		1 10
Oct. 27	Mrs. C. J. Schubert	906	Premiums		12 37
Oct. 27	Mrs. John F. Stout	907	Premiums		4 78
Oct. 27	Mrs. G. A. Sheller	908	Premiums		1 10
Oct. 27	Mrs. M. R. Schwake	909	Premiums		1 32
Oct. 27	Beulah Sharp	910	Premiums		1 10
Oct. 27	Mrs. S. H. Smith	911	Premiums		27
Oct. 27	Ida Sharp	912	Premiums		2 20
Oct. 27	Miss Mabel Stulet	913	Premiums		1 37
Oct. 27	Mrs. E. B. Steadman	914	Premiums		1 37
Oct. 27	Josephine Stafford	915	Premiums		1 10
Oct. 27	Grace Sheller	916	Premiums		1 37
Oct. 27	Elizabeth A. Shortliff	917	Premiums		1 75
Oct. 27	Mattie E. Stephens	918	Premiums		2 42
Oct. 27	Harry M. Stokes	919	Premiums		3 95
Oct. 27	P. E. B. Sill	920	Premiums		1 32
Oct. 27	C. K. Struble	921	Premiums		1 10
Oct. 27	Seward Creamery Co.	922	Premiums		3 20
Oct. 27	C. F. Schwager	923	Premiums		5 02
Oct. 27	Z. M. Schwab	924	Premiums		2 20
Oct. 27	Mrs. J. M. Stafford	925	Premiums		55
Oct. 27	Mrs. E. H. Skinrock	926	Premiums		55
Oct. 27	Miss Rena Smith	927	Premiums		1 10
Oct. 27	Ora Shinrock	928	Premiums		1 10
Oct. 27	William Sievers	929	Premiums		2 20
Oct. 27	L. D. Stilson	930	Premiums		55
Oct. 27	Saline Co. Agr. Soc.	931	Premium and switching		105 14
Oct. 27	Wm. Stolley	932	Premium		3 52
Oct. 27	Sioux Co. Agr. Soc.	933	Premium		13 97
Oct. 27	Elmer Thompson	934	Premium and switching		7 40
Oct. 27	J. B. Thompson	935	Premium and switching		9 70
Oct. 27	J. B. Thompson	936	Premium		3 00
Oct. 27	J. B. Thompson	937	Premium		10 00
Oct. 27	J. W. Townley	938	Premium		19 35
Oct. 27	W. H. Taylor & Son	939	Premium and switching		32 05
Oct. 27	Robert Taylor	940	Premiums		20 90
Oct. 27	O. D. Talbret	941	Premiums		4 78
Oct. 27	J. L. Todd	942	Premiums		11 98
Oct. 27	Thiem & Todd	943	Premiums		82
Oct. 27	Geo. E. Turner	944	Premiums		1 10
Oct. 27	Will Turner	945	Premiums		2 20
Oct. 27	J. W. Taylor	946	Premiums		16 15
Oct. 27	Mrs. E. Tyner	947	Premiums		82
Oct. 27	Pearl E. Tyner	948	Premiums		1 32
Oct. 27	Myra D. Tomlison	949	Premiums		1 10
Oct. 27	Mrs. A. J. Thompson	950	Premiums		1 10
Oct. 27	H. Turner	951	Premiums		1 10
Oct. 27	Grace Thurston	952	Premiums		9 07
Oct. 27	Jean M. Thurston	953	Premiums		7 10
Oct. 27	K. B. Tiderman	954	Premiums		2 15
Oct. 27	Jas. J. Thompson	955	Premiums		1 98
Oct. 27	Thayer Co. Agr. Soc.	956	Premiums		93 02

Digitized by Google

LIST OF WARRANTS, 1897—*Concluded.*

DATE.	TO WHOM ISSUED.	NO.	FOR WHAT PURPOSE.	MISC.	PREM.
Oct. 27	Vanderslice Bros.	957	Premium		31 68
Oct. 27	Wolcott Bros.	958	Premium and switching		15 87
Oct. 27	Wolcott Bros.	959	Premium		9 00
Oct. 27	T. R. Westrope	960	Premium and switching		19 83
Oct. 27	J. B. Webb	961	Premiums		5 88
Oct. 27	J. A. Wheeler	962	Premiums		7 42
Oct. 27	W. V. Welch	963	Premiums		2 15
Oct. 27	R. Whitehead	964	Premiums		3 45
Oct. 27	Sam Warrick	965	Premiums		7 48
Oct. 27	A. Waller	966	Premiums		1 10
Oct. 27	Joel Wright	967	Premiums		3 02
Oct. 27	John West	968	Premiums		2 15
Oct. 27	Mrs. Mary Weyerman	969	Premiums		2 20
Oct. 27	Jane B. Winston	970	Premiums		3 30
Oct. 27	Mrs. D. Welchman	971	Premiums		55
Oct. 27	Mrs. W. H. Wigham	972	Premiums		1 32
Oct. 27	Josie L. Wilmot	973	Premiums		2 20
Oct. 27	Mrs. Anna Wilson	974	Premiums		1 10
Oct. 27	Ruth Weller	975	Premiums		82
Oct. 27	Mrs. J. Whiney	976	Premiums		1 10
Oct. 27	Mrs. C. B. White	977	Premiums		1 37
Oct. 27	Hattie Whittlesey	978	Premiums		1 32
Oct. 27	Mrs. A. Wickstrom	979	Premiums		1 10
Oct. 27	Mary L. Ward	980	Premiums		1 10
Oct. 27	Mrs. S. G. Wright	981	Premiums		1 32
Oct. 27	Mrs. B. H. Wasek	982	Premiums		55
Oct. 27	J. E. Wigman	983	Premiums		2 20
Oct. 27	G. M. Whitford	984	Premiums		2 42
Oct. 27	Don Westcott	985	Premiums		8 47
Oct. 27	Mrs. E. Whitcomb	986	Premiums		5 40
Oct. 27	A. N. Ballard	987	Premiums		163 90
Oct. 27	Wash'ton Co. Agr. Soc	988	Premiums		56 10
Oct. 27	M. F. Yegge	989	Premiums		27 05
Oct. 27	H. C. Young	990	Premiums		18 40
Oct. 27	J. V. Yegge	991	Premiums		4 10
Oct. 27	Ida B. Young	992	Premiums		55
Oct. 27	York Roller Mills	993	Premiums		55
Oct. 27	Pearl Younger	994	Premiums		8 50
Oct. 27	York Co. Agr. Soc	995	Premiums		80 38
Oct. 27	Frank Zachary	996	Premiums		3 50
Oct. 27	H. Zink & Son	997	Premiums		1 90
Oct. 27	Harry C. Hobble	998	Premiums		1 10
Nov. 3	Robt. W. Furnas	999	Salary and allowance, October	216 00	
Nov. 3	L. Royce	1000	Postage, October, 1897	10 13	
Nov. 3	Jno. B. Lewis	1001	Frt., Tel., and Ex., October, 1897	10 11	
Nov. 10	R. W. Furnas	1002	Expense Delegate	20 50	
Nov. 10	Sharples Co	1003	Salt	70	
Nov. 10	Rees Printing Co	1004	Supplies	10 75	
Nov. 12	Dr. A. T. Peters	1005	Services at Fair, 1897	19 00	
Nov. 15	S. F. Gilman	1006	Feed	159 25	
Nov. 15	Nebraska Hay Co	1007	Hay and straw	35 22	
Nov. 18	Jno. B. Lewis	1008	Frt., Tel., and Ex., November 1-15	4 85	
Dec. 1	Robt. W. Furnas	1009	Sal. and allowance, November, '97	216 00	
Dec. 1	L. Royse	1010	Postage, 1897	1 57	
Dec. 2	Norval Bros	1011	Costs, Moore suit	25 00	
Dec. 11	Hotel Millard	1012	Hotel bill	19 00	
Dec. 11	Rees Printing Co	1013	Supplies	5 00	
Dec. 29	Andrew Kiewit	1014	Bal. Printing Premium List, 1897	84 07	
Dec. 31	R. W. Furnas	1015	Bal., Sal., and allowance, 1897	224 00	
Dec. 31	Lloyd Royse	1016	Postage, December, 1897	4 70	
Dec. 31	J. B. Lewis	1017	Frt., Tel., and Ex.	10 20	
				$23110 81	$ 12267 45
			Total		$ 35378 26

Digitized by Google

RECAPITULATION, PAGE ADDITIONS CASH WARRANTS.

PAGE.	MISCELLANEOUS.	PREMIUM.
1	$ 1,395 80	$ 72 50
2	1,944 58	.....
3	1,337 34	.....
4	2,181 35	.....
5	405 65	322 09
6	.....	265 03
7	1,250 59	38 96
8	3,123 35	682 00
9	1,352 47	220 00
10	1,265 46	601 64
11	.....	1,328 31
12	.....	1,886 57
13	.....	1,679 94
14	1,914 81	611 34
15	2,209 15	13 00
16	1,387 32	.....
17	2,266 89	7 14
18	.....	249 99
19	.....	267 31
20	.....	478 49
21	.....	189 16
22	.....	165 18
23	.....	278 95
24	.....	609 47
25	.....	156 40
26	.....	396 57
27	.....	251 59
28	.....	239 60
29	.....	299 82
30	.....	167 87
31	.....	365 31
32	.....	327 84
33	1,076 05	95 38
	$23,110 81	$12,267 45
Miscellaneous amounts		23,110 81
Premium amounts		12,367 45
Total		$35,387 26

Digitized by Google

LIST OF TIME WARRANTS.

Issued in payment of 45 per cent on premiums for the year 1897 and payable in 1899.

TO WHOM ISSUED.	NO.	FOR WHAT PURPOSE.	MISC.	PREM.
Thos. Andrews & Son	1	Premiums		$ 34 20
Ben Aldritt	2	Premiums		5 40
P. C. Aylesworth	3	Premiums		5 40
Arnold Bros.	4	Premiums		10 08
E. H. Andrews	5	Premiums		3 96
W. A. Armstrong	6	Premiums		12 42
W. R. Anthony	7	Premiums		90
Mrs. L. L. Allen	8	Premiums		4 14
Mrs. Josephine Allen	9	Premiums		2 70
Fred Allen	10	Premiums		90
F. A. Burt	11	Premiums		10 08
James Barrett	12	Premiums		3 60
Ben Buercher	13	Premiums		90
J. Boileau & Son	14	Premiums		21 33
Geo. Bothwell	15	Premiums		11 52
W. E. Brown	16	Premiums		12 96
J. Benson & Son	17	Premiums		4 68
R. L. Blodgett & Son	18	Premiums		1 08
C. H. Ballinger	19	Premiums		25 56
W. J. Boynton	20	Premiums		14 94
F. E. Baldwin	21	Premiums		7 56
C. E Boggs	22	Premiums		68
A. P. Brady	23	Premiums		4 24
Oscar Bock	24	Premiums		68
J. Babler	25	Premiums		2 16
Wm. Bostain	26	Premiums		1 35
Buck Bros.	27	Premiums		22 77
O. N. Birkett	28	Premiums		2 79
J. H. Blodgett	29	Premiums		6 48
S. D. Bouvier	30	Premiums		3 11
J. Ballard	31	Premiums		13 59
N. E. Bartholomew	32	Premiums		9 95
J. P. Brown	33	Premiums		1 08
W. T. Brown	34	Premiums		1 08
B. F. Bell	35	Premiums		1 35
D. N. Blood	36	Premiums		1 35
Mrs. O. E. Bunnell	37	Premiums		68
Mrs. J. H. Blodgett	38	Premiums		3 03
Mrs. Mary Baroch	39	Premiums		23
Edith Blunk	40	Premiums		23
Mrs. Hanna Balliet	41	Premiums		90
Mrs. Maggie Bishop	42	Premiums		2 70
Mrs. M. A. Bock	43	Premiums		68
Mil ie and Mable Brown	44	Premiums		8 33
Mrs. M. M. Butterfield	45	Premiums		17 24
Mrs. G. F. Bergen	46	Premiums		1 13
Mrs. W. G. Bradbury	47	Premiums		23
Mrs. E. C. Barr	48	Premiums		1 35
Mrs. Clara Belden	49	Premiums		1 80
Martha L. Baker	50	Premiums		1 08
Mrs. A. L. Burr	51	Premiums		90
Mrs. P. H. Brunner	52	Premiums		2 70
Nellie A. Burnum	53	Premiums		1 08
Boone County Agr. Society	54	Premiums		75 96
I. W. Chappell	55	Premiums		17 55
W. H. Chapman	56	Premiums		8 91
C. A. Cook	57	Premiums		8 20
A. W. Covall & Son	58	Premiums		68
U. Cachlein	59	Premiums		5 76
S. G. Culbertson	60	Premiums		68
J. E. Carey	61	Premiums		68
P. Chancey	62	Premiums		68
Geo. Cant	63	Premiums		45
J. Carley	64	Premiums		90
Jas. Collen	65	Premiums		45
L. M. Copeland	66	Premiums		1 80
C. Carpenter	67	Premiums		90
Geo. Cowles	68	Premiums		90

Digitized by Google

LIST OF TIME WARRANTS—*Continued.*

TO WHOM ISSUED.	NO.	FOR WHAT PURPOSE.	MISC.	PREM.
Crete Mills	69	Premiums		$ 1 35
Mrs. W. C. Crooks	70	Premiums		1 35
Miss Mary Cabell	71	Premiums		45
Miss Anna Chase	72	Premiums		90
Margaret B. Cooke	73	Premiums		1 5[illegible]
Mrs. Clara Cutler	74	Premiums		23
Misses Clark & Wetzell	75	Premiums		1 35
Mrs. C. J. Crooks	76	Premiums		5 40
Mrs. J. E. Cramer	77	Premiums		2 70
Mrs. A. T. Carter	78	Premiums		1 80
Ada M. Conoway	79	Premiums		45
Mrs. S. L. Caldwell	80	Premiums		90
Caledonia Creamery Company	81	Premiums		4 93
Cuming County Agr. Society	82	Premiums		75 33
W. T. DeClow	83	Premiums		6 57
D. Davis & Son	84	Premiums		11 70
Davidson & Chrystner	85	Premiums		1 80
Dawson Bros. & Co	86	Premiums		32 40
Casper Dice	87	Premiums		7 02
Aug. Davidson	88	Premiums		15 62
C. E. Drake	89	Premiums		3 33
S. Davis	90	Premiums		90
A. K. Dinge	91	Premiums		1 08
O. Denkins	92	Premiums		1 35
J. W. Diller	93	Premiums		90
J. Drummond	94	Premiums		4 95
C. C. Deyo	95	Premiums		90
John Dorritty	96	Premiums		1 80
Mrs. G. H. Devereaux	97	Premiums		1 58
Mrs. G. B. Dake	98	Premiums		45
Mrs. G. A. Diels	99	Premiums		1 53
Mrs. H. L. Day	100	Premiums		1 53
Mrs. H. J. Dodson	101	Premiums		45
Mrs. A. M. Darling	102	Premiums		2 25
Mrs. O. W. Davenport	103	Premiums		45
Nora Daugherty	104	Premiums		45
Mrs. E Dailey	105	Premiums		45
Mrs. C. W. Downs	106	Premiums		3 78
R. W. Douglas	107	Premiums		3 24
Mrs. B. J. Drummon	108	Premiums		1 80
Arthur Dirkson	109	Premiums		90
Dundy County Agr. Society	110	Premiums		44 95
Dawes County Agr. Society	111	Premiums		37 59
Dawson County Agr Society	112	Premiums		36 18
J. C. Edwards	113	Premiums		5 40
C. H. Elmendorf	114	Premiums		24 30
E. H Eggert	115	Premiums		18 23
F. P. Englemann	116	Premiums		23
Wm. Ellsworth	117	Premiums		1 08
Minnie B. Ellis	118	Premiums		2 25
Mrs. F. W. Emmerson	119	Premiums		5 45
G. E. Edlund	120	Premiums		90
D. Fisher	121	Premiums		2 16
Thos. Foster	122	Premiums		4 32
L. S. Frantz	123	Premiums		1 35
L. Fester	124	Premiums		1 08
Wm. Furney	125	Premiums		1 35
Albert Funks	126	Premiums		45
Mrs. J. B. Ferguson	127	Premiums		1 08
Mary France	128	Premiums		45
Mary Fassett	129	Premiums		23
Mrs. J. W. Fead	130	Premiums		1 75
Mrs Thos. Furgeson	131	Premiums		68
Belle Finley	132	Premiums		45
Mrs. M. H. Ford	133	Premiums		14 54
Alice Furay	134	Premiums		2 34
Walter Fischel	135	Premiums		90
Mrs. R. D. Fitch	136	Premiums		2 70
Mabel Fairchild	137	Premiums		45
Connie J. Furay	138	Premiums		2 25

Digitized by Google

LIST OF TIME WARRANTS—*Continued.*

TO WHOM ISSUED.	NO.	FOR WHAT PURPOSE.	MISC.	PREM.
Claude Fordyce	139	Premiums		$ 1 80
Furnas County Agr. Society	140	Premiums		51 21
Fillmore County Agr. Society	141	Premiums		50 12
Frontier County Agr. Society	142	Premiums		37 90
C. F. Gollehorn	143	Premiums		7 20
L. B. Goodrich	144	Premiums		13 05
E. M. Gibson	145	Premiums		1 80
Henry Glissman	146	Premiums		4 32
W. A. Gronaweg	147	Premiums		5 40
C. T. Graves	148	Premiums		56 25
H. C. Glissman & Son	149	Premiums		7 38
Reuben Gentry	150	Premiums		13 14
W. M. Gilmore & Son	151	Premiums		17 64
O. E. Graves	152	Premiums		1 75
Dr. O. Gaiser	153	Premiums		6 48
W. G. Gooden	154	Premiums		68
S. J. Garoutte	155	Premiums		2 16
S. J. Gadd	156	Premiums		5 49
Chas. Gran	157	Premiums		7 29
R. Grooms	158	Premiums		90
Mrs. F. E. Gage	159	Premiums		9 68
Mrs. A. G. Greenlee	160	Premiums		7 74
Harriet Goss	161	Premiums		90
Mrs. J. C. Gardiner	162	Premiums		45
Mary E. Gratton	163	Premiums		45
Robt. F. Gilden	164	Premiums		2 58
Jenuie L. Groves	165	Premiums		1 35
Margeritte Gentzke	166	Premiums		45
Gage County Agr. Society	167	Premiums		51 05
J. M. Harrison	168	Premiums		10 08
O. H. Hillis	169	Premiums		2 52
W. S. Hiatt	170	Premiums		4 32
O. P. Hendershott	171	Premiums		2 52
W. H. Heil & Bro	172	Premiums		58 36
Hudson & Foster	173	Premiums		13 90
E. R. Hitchcock	174	Premiums		4 32
Jos. Hynek & Son	175	Premiums		2 88
Jacob Hetrick	176	Premiums		2 84
H. W. Hewitt	177	Premiums		68
W. S. Hillis	178	Premiums		68
F. C. Hinman	179	Premiums		2 84
L. P. Harris	180	Premiums		6 08
E. L. Houtz	181	Premiums		2 43
E. Hays	182	Premiums		5 58
O. P. Hendershott	183	Premiums		6 30
J. W. Hawkins	184	Premiums		1 08
Henry Hadley	185	Premiums		45
John Havens	186	Premiums		45
Oscar G. Houck	187	Premiums		90
Anna M. Harris	188	Premiums		7 65
Anna Hudson	189	Premiums		1 75
Mrs. E. C. Hill	190	Premiums		6 08
Mrs. L. Hirsch	191	Premiums		4 05
Mary E. Hayes	192	Premiums		2 70
Dora Harney	193	Premiums		1 08
Mrs. Geo. Hendree	194	Premiums		68
Lou Houchin	195	Premiums		45
A. Hospe	196	Premiums		1 80
Chas. Hogle	197	Premiums		2 88
Louise S. Hobbie	198	Premiums		1 44
Harrie C. Hobbie	199	Premiums		90
Heyn The Photographer	200	Premiums		90
Hadley & Place	201	Premiums		2 03
A. F. Hartwell	202	Premiums		2 43
Mrs. J. W. Hood	203	Premiums		45
Mrs. R. H. Howard	204	Premiums		90
Eva Howard	205	Premiums		90
W. A. Irwin	206	Premiums		5 67
Harry Johnson	207	Premiums		21 42
D. B. Jones	208	Premiums		19 70

Digitized by Google

LIST OF TIME WARRANTS—*Continued.*

TO WHOM ISSUED.	NO.	FOR WHAT PURPOSE.	MISC.	PREM.
J. Cook Johnson	209	Premiums		$ 1 08
Mark Jewett	210	Premiums		90
E. D. Johnson	211	Premiums		15 45
William James	212	Premiums		5 30
Nels Johnson	213	Premiums		45
Miss Margaret Jackson	214	Premiums		5 35
Mrs. Emma James	215	Premiums		23
Mrs. Hilda C. Johnson	216	Premiums		45
Mrs. H. A. Johnson	217	Premiums		1 35
Gertrude Johnson	218	Premiums		45
Hannah B. Johnson	219	Premiums		68
Mrs. H. Jensen	220	Premiums		90
Lillie Jonasen	221	Premiums		90
Mrs. C. Juleson	222	Premiums		45
Mrs. J. M. Johnson	223	Premiums		45
Mrs. L. Jensen	224	Premiums		4 42
Keystone Stock Farm	225	Premiums		5 40
John A. Kenny	226	Premiums		1 08
Robert Keel	227	Premiums		90
W. H. Kelley	228	Premiums		45
Mrs. J. F. King	229	Premiums		7 38
Annie Kruse	230	Premiums		45
Belle Keyser	231	Premiums		2 03
Amy B. King	232	Premiums		90
Frederick Knight	233	Premiums		2 88
Winifred Kimball	234	Premiums		1 08
Wilber F. King	235	Premiums		1 65
J. J. King	236	Premiums		6 27
E. Ketchmer	237	Premiums		34 30
Ray Kretchmer	238	Premiums		3 05
Kearney County Agr. Society	239	Premiums		64 99
	240	Premiums		
J. Lightbody	241	Premiums		4 22
J. W. Lash	242	Premiums		9 72
Mrs. A. B. Lathrop	243	Premiums		9 40
H. B. Louden & Son	244	Premiums		1 80
P. R. Longfellow	245	Premiums		3 10
A. Lemen	246	Premiums		7 43
O. H. Lutz	247	Premiums		7 38
D. M. Lewis	248	Premiums		1 08
David Larson	249	Premiums		5 40
R. D. Leard	250	Premiums		4 32
E. F. Lehman	251	Premiums		1 80
M. W. Lilley	252	Premiums		1 08
Peter Larsen	253	Premiums		1 08
Henry Lamb	254	Premiums		1 75
Mrs. G. B. Lathrop	255	Premiums		45
Mrs. Frances Lehmen	256	Premiums		1 08
Mrs. J. B. Lewis	257	Premiums		90
Mrs. C. E. Leslie	258	Premiums		1 53
Orson Lowell	259	Premiums		5 76
Margaret Livingston	260	Premiums		1 98
Mrs. S. G. Lund	261	Premiums		90
W. W. Ladd	262	Premiums		5 85
Lovesy & Bouck	263	Premiums		2 70
Mrs. R. M. Lewis	264	Premiums		2 88
C. M. Lewelling	265	Premiums		3 60
J. E. Miller	266	Premiums		11 88
J. H. McCordle	267	Premiums		4 32
D. T. Mount	268	Premiums		19 08
J. H. McAllister	269	Premiums		65 88
E. B. Mitchell & Son	270	Premiums		19 62
W. A. McHenry	271	Premiums		46 80
W. Guy McCandless	272	Premiums		21 78
Mrs. W. Guy McCandless	273	Premiums		68
L. E. Mahan & Co	274	Premiums		78 57
C. M. Morton	275	Premiums		3 60
W. H. McCall	276	Premiums		66 24
Meissner Bros	277	Premiums		10 08
Sam McKelvie	278	Premiums		10 05

Digitized by Google

LIST OF TIME WARRANTS—*Continued.*

TO WHOM ISSUED.	NO.	FOR WHAT PURPOSE.	MISC.	PREM.
J. Mandelbaum	279	Premiums		$ 13 32
J. S. Magers	280	Premiums		2 16
Geo. McKerrow	281	Premiums		55 08
E. W. Martin	282	Premiums		2 85
W. A. Melson	283	Premiums		5 27
G. O. Monroe	284	Premiums		1 35
Willie Mumaugh	285	Premiums		68
Lewis Mena	286	Premiums		1 08
W. A. McCool	287	Premiums		9 32
P. Murphy	288	Premiums		1 00
J. L. McMinn	289	Premiums		10 70
F. Mann	290	Premiums		68
E. Marsh	291	Premiums		68
B. F. Muman	292	Premiums		2 85
John Mahatt	293	Premiums		1 80
H. Miller	294	Premiums		90
Mrs. I. J. McDonald	295	Premiums		5 18
Mrs. M. McLane	296	Premiums		5 75
Mrs. A. W. McLaughlin	297	Premiums		6 08
Mrs. C. A. Mansfield	298	Premiums		45
Mrs. W. R. Morand	299	Premiums		1 13
Mrs. L. F. Maguin	300	Premiums		45
Miss Monnell	301	Premiums		1 75
Mae McKenzie	302	Premiums		90
Mrs. C. Melcline	303	Premiums		90
Mrs. Robt. McPherson	304	Premiums		3 33
Mrs. H. S. Murdock	305	Premiums		13 28
Mrs. G. Morgan	306	Premiums		90
Mrs. T. Mittauer	307	Premiums		2 25
Mrs. M. G. McCague	308	Premiums		45
Mrs. Richard Morrell	309	Premiums		1 45
Mrs. R. A. McLoskey	310	Premiums		90
Mrs. R. A. McEachron	311	Premiums		90
Mrs. E. Mae Millan	312	Premiums		1 35
Ada E. Maginn	313	Premiums		45
Cynthia M. McCague	314	Premiums		1 13
Mary Murray	315	Premiums		90
Merrick County Agr. Society	316	Premiums		31 32
Alma B. Miekle	317	Premiums		4 68
Mrs. J. C. Morrow	318	Premiums		11 07
Mrs. M. F. Morrill	319	Premiums		21 23
Mrs. E. Mun	320	Premiums		90
M. H. Manley & Co	321	Premiums		2 97
M. Ethel McKay	322	Premiums		45
Mrs. G. Marty	323	Premiums		45
M. E. Newburn	324	Premiums		83 16
R. L. Newton	325	Premiums		5 00
Nims Bros	326	Premiums		16 52
Emma J. Nichol	327	Premiums		1 58
Mrs. G. W. Nalle	328	Premiums		2 70
Jas. Novacek	329	Premiums		1 58
Ala Petford Neville	330	Premiums		2 34
Mrs. J. W. Nash	331	Premiums		2 25
Nixon & Laughlin	332	Premiums		53 64
Nuckolls County Agr. Society	333	Premiums		38 38
Rollo Oliver	334	Premiums		28 44
John W. Oliver	335	Premiums		4 68
J. Ockander	336	Premiums		1 35
J. K. O'Neill	337	Premiums		2 52
Mrs. T. M. Orr	338	Premiums		9 85
A. E. Olander	339	Premiums		3 30
H. J. Palmer	340	Premiums		9 00
Mrs. Emma Pickard	341	Premiums		4 32
Patrick Bros	342	Premiums		3 60
E. A. Pegler	343	Premiums		7 15
Frank Patton	344	Premiums		1 08
Perkins Bros	345	Premiums		6 75
I. Payne	346	Premiums		2 15
Oscar Pflug	347	Premiums		1 80
Geo. Pflug	348	Premiums		

Digitized by Google

LIST OF TIME WARRANTS—*Continued.*

TO WHOM ISSUED.	NO.	FOR WHAT PURPOSE.	MISC.	PREM.
John Pew	349	Premiums		$ 8 13
Cecil Pew	350	Premiums		8 20
J. V. Porter	351	Premiums		1 08
Frank Pign	352	Premiums		1 80
Sam Peterson	353	Premiums		1 08
Frank Peterson	354	Premiums		4 65
H. V. Persons	355	Premiums		45
H. Peterson	356	Premiums		45
Mary Peterson	357	Premiums		45
Mrs. James Peterson	358	Premiums		3 10
Mrs. M. A. Paynes	359	Premiums		7 65
Anna H. Partridge	360	Premiums		90
Ethel H. Partridge	361	Premiums		45
Ellen Parrish	362	Premiums		45
Mrs. Eli Plummer	363	Premiums		1 58
Mrs. W. C. Pritchard	364	Premiums		1 13
Mrs. Albert Perkins	365	Premiums		1 08
Nellie J. Perfect	366	Premiums		45
Mrs. E. R. Perfect	367	Premiums		1 98
Charles G. Powell	368	Premiums		3 42
L. Belle Perfect	369	Premiums		13 68
Mrs. V. M. Parks	370	Premiums		3 78
Charlotte K. Poppleton	371	Premiums		1 80
C. W. Poynter	372	Premiums		6 48
Mrs. Mary Peterson	373	Premiums		90
Maud Peterson	374	Premiums		90
J. Prichard	375	Premiums		90
Rhea Bros.	376	Premiums		2 78
C. S. Rex	377	Premiums		5 40
E. Reynolds & Son	378	Premiums		19 45
Risk & Gabbert	379	Premiums		3 60
Wm. Roberts & Son	380	Premiums		61 20
A. J. Richardson	381	Premiums		22 68
George Richardson	382	Premiums		17 82
G. & D. J. Richards	383	Premiums		5 27
Charles Ross	384	Premiums		3 24
E. G. Roberts & Co	385	Premiums		57 75
Richard Ran	386	Premiums		1 35
M. Robbins	387	Premiums		15 70
Herman Roessig	388	Premiums		9 77
Fred Rasch	389	Premiums		2 47
T. O. Rich	390	Premiums		1 08
George Ross	391	Premiums		1 58
Thomas Reed	392	Premiums		45
J. F. Rosenfield	393	Premiums		90
Wm. Rosa	394	Premiums		90
J. A. Robeson	395	Premiums		4 95
Martha Robbins	396	Premiums		1 80
Mrs. M. J. Reed	397	Premiums		23
Mrs. H. G. Rockfellow	398	Premiums		45
Mrs. A. Root	399	Premiums		90
Miss A. Rich	400	Premiums		45
Mrs W. B. Rutherford	401	Premiums		45
Mrs. C. Reed	402	Premiums		2 25
Mrs. R. J. Robeson	403	Premiums		1 58
Blanch Roe	404	Premiums		1 35
Charlotte Roe	405	Premiums		45
Mrs. A. T. Rector	406	Premiums		3 24
Mrs. C. U. Rose	407	Premiums		90
Mrs. James A. Ryan	408	Premiums		1 35
Raymond Creamery Company	409	Premiums		2 47
Edith Robbins	410	Premiums		1 80
Red Willow County Agr. So.	411	Premiums		38 70
A. L. Sullivan	412	Premiums		21 25
W. H. Sylvester	413	Premiums		11 12
S. W. Stewart	414	Premiums		5 75
Standard Trotting Horse Co.	415	Premiums		29 15
E. N. Sherrill	416	Premiums		1 98
Smith & Shin	417	Premiums		1 35
Stanton Breeding Company	418	Premiums		50 05

Digitized by Google

LIST OF TIME WARRANTS—*Continued.*

TO WHOM ISSUED.	NO.	FOR WHAT PURPOSE.	MISC.	PREM.
J. Stagman & Son	419	Premiums		$ 7 20
C. F. Stone	420	Premiums		7 20
H. G. Sims	421	Premiums		2 52
W. Z. Swollow & Son	422	Premiums		2 88
C. H. Searles	423	Premiums		30 95
F. J. Shugart	424	Premiums		2 15
E. O. Spencer	425	Premiums		3 50
W. N. Smith	426	Premiums		1 08
Southwick & Barclay	427	Premiums		32 40
John Skinner	428	Premiums		8 10
Raymond Striker	429	Premiums		2 43
J. F. Schiffman	430	Premiums		4 32
A. T. Stearns	431	Premiums		3 25
C. M. Sanders	432	Premiums		2 55
Fred Schoenig	433	Premiums		2 70
J. S. Shivers	434	Premiums		45
Lee Smith	435	Premiums		19 45
M. H. Smith	436	Premiums		5 40
Joe. St. Louis	437	Premiums		90
R. Struble	438	Premiums		1 08
T. Sackett	439	Premiums		68
B. F. Shults	440	Premiums		1 80
S. Spellman	441	Premiums		4 28
J. Stewart	442	Premiums		1 80
N. Shafer	443	Premiums		68
A. Strenglein	444	Premiums		90
S. E. Solomon	445	Premiums		90
J. W. Shuman	446	Premiums		45
Geo. Shrimpton & Son	447	Premiums		1 35
Mrs. M. E. Shumway	448	Premiums		2 03
Mrs. J. B. Shickley	449	Premiums		90
Mrs. C. J. Schubert	450	Premiums		10 13
Mrs. John F. Stout	451	Premiums		3 92
Mrs. G. A. Sheller	452	Premiums		90
Mrs. M. R. Schwake	453	Premiums		1 08
Beulah Sharp	454	Premiums		90
Mrs. S. H. Smith	455	Premiums		23
Ida Sharp	456	Premiums		1 80
Miss Mable Stulet	457	Premiums		1 13
Mrs. E. B. Steadman	458	Premiums		1 53
Josephine Stafford	459	Premiums		90
Grace Sheller	460	Premiums		1 13
E. A. Shortliff	461	Premiums		1 45
Mattie E. Stephens	462	Premiums		1 98
Harry M. Stokes	463	Premiums		3 25
P. E. B. Sill	464	Premiums		1 08
C. K. Struble	465	Premiums		90
Seward Creamery Co	466	Premiums		2 62
C. F. Schwager	467	Premiums		4 10
J. M. Schwab	468	Premiums		1 80
Mrs. J. M. Stafford	469	Premiums		45
Mrs. E. H. Shinrock	470	Premiums		45
Miss Rena Smith	471	Premiums		90
Ora Shinrock	472	Premiums		90
Wm. Sievers	473	Premiums		1 80
L. D. Stilson	474	Premiums		45
Saline County Agr. Society	475	Premiums		81 13
Wm. Stolley	476	Premiums		2 88
Sioux County Agr. Society	477	Premiums		11 44
Elmer Thompson	478	Premiums		3 60
J. B. Thompson	479	Premiums		5 50
J. W. Townley	480	Premiums		15 85
W. H. Taylor	481	Premiums		23 75
Robt. Taylor	482	Premiums		17 10
O. D. Talbret	483	Premiums		3 92
J. L. Todd	484	Premiums		9 77
Theim & Todd	485	Premiums		68
Geo. E. Turner	486	Premiums		90
Will Turner	487	Premiums		1 80
J. H. Taylor	488	Premiums		10 75

Digitized by Google

LIST OF TIME WARRANTS—*Concluded.*

TO WHOM ISSUED.	NO.	FOR WHAT PURPOSE.	MISC.	PREM.
Mrs. E. Tyner	489	Premiums		$ 68
Pearl E. Tyner	490	Premiums		1 08
Myra D. Tomilson	491	Premiums		90
Mrs. A. J. Thompson	492	Premiums		90
H. Turner	493	Premiums		90
Miss Grace Thurston	494	Premiums		7 43
Miss Jean M. Thurston	495	Premiums		5 80
K. B. Tiderman	496	Premiums		1 75
J. J. Thompson	497	Premiums		1 62
Thayer County Agr. Society	498	Premiums		76 11
Vanderslice Bros	499	Premiums		25 92
Wolcott Bros	500	Premiums		10 53
T. R. Westrope & Son	501	Premiums		13 77
J. B. Webb	502	Premiums		4 82
J. A. Wheeler	503	Premiums		6 08
W. V. Welch	504	Premiums		1 75
R. Whitehead	505	Premiums		2 85
Sam Warrick	506	Premiums		6 12
A. Waller	507	Premiums		90
Joel Wright	508	Premiums		2 48
John West	509	Premiums		1 75
Mrs. Mary Weyerman	510	Premiums		1 80
Jane B. Winston	511	Premiums		2 70
Mrs. D. Weichman	512	Premiums		45
Mrs. W. H. Wigham	513	Premiums		1 08
Josie E. Wilmot	514	Premiums		1 80
Mrs. Anna Wilson	515	Premiums		90
Miss Ruth Weller	516	Premiums		68
Miss J. Whiney	517	Premiums		90
Miss C. B. White	518	Premiums		1 13
Hattie Whittlesey	519	Premiums		1 08
Mrs. A. Wickstrom	520	Premiums		90
Mary L. Ward	521	Premiums		90
Mrs. S. G. Wright	522	Premiums		1 08
Mrs. B. H. Wasek	523	Premiums		45
J. E. Wigman	524	Premiums		1 80
G. M. Whitford	525	Premiums		1 58
Don Westcott	526	Premiums		6 93
Mrs. E. Whitcomb	527	Premiums		4 40
Washington Co. Agr. Society	528	Premiums		134 10
Washington Co. Agr. Society	529	Premiums		45 10
M. F. Yegge	530	Premiums		22 15
H. C. Young	531	Premiums		15 10
J. V. Yegge	532	Premiums		3 40
Ida B. Young	533	Premiums		45
York Roller Mills	534	Premiums		45
Pearl Younger	535	Premiums		7 00
York County Agr. Society	536	Premiums		65 78
Frank Zachary	537	Premiums		2 90
H. Zink & Son	538	Premiums		1 60
O. A. Brown	539	Premiums		7 89
Geo. Roberts	540	Premiums		7 87
H. C. Kaley	541	Premiums		7 89
E. Crum	542	Premiums		7 87

RECAPITULATION, PAGE ADDITIONS, TIME WARRANTS.

PAGE.	AMOUNT.	PAGE.	AMOUNT.
1	$ 262 11	11	$ 817 12
2	170 60	12	199 15
3	193 09	13	224 52
4	207 66	14	207 48
5	335 67	15	167 0‹
6	208 97	16	237 76
7	102 44	17	823 64
8	225 49		
9	477 59		$3,997 06
10	136 69		

Digitized by Google

The By-laws so providing, the President, in advance of this meeting, appointed as Auditing Committee William R. Bowen, Douglas county; C. R. Glover, Dawes county; A. Humphrey, Lancaster county.

To this committee had been referred all financial statements and reports of Treasurer and Secretary. Mr. Bowen, from this committee, reported as follows, and the report was adopted:

REPORT OF AUDITING COMMITTEE.

January 18, 1898.

To the State Board of Agriculture:

Your Auditing Committee has scrutinized the 1897 accounts of your Secretary and Treasurer and find same to agree and to be correct.

All payments that have been made by your Treasurer have been on warrants regularly drawn by your Secretary, same being based on the order of the full State Board, on the order of your President, on vouchers approved by your Board of Managers, or for premiums and fixed salaries.

The balance in the hands of the Treasurer, January 19, 1897 (see page 37 printed report of 1896) was		$ 332 93
Receipts during year now ending		38,506 61
		$38,839 54
1896 warrants paid by Treasurer	$ 2,279 67	
1896 warrants paid by reissue	$72 50	
1897 warrants paid by Treasurer	35,111 01	37,390 68
Balance on hand January 18, 1898		$1,448 86

There remain unpaid the following warrants:

Series of 1890, 1891, 1892, 1893, 1894, and 1895 (see page 37, printed report of 1896)		$183 76
Series of 1897 outstanding:		
No. 140	$ 1 10	
" 164	1 32	
" 191	82	
" 193	82	
" 412	6 67	
" 475	10 10	
" 495	9 92	
" 527	27	
" 533	1 10	
" 549	2 20	
" 554	55	
" 557	55	
" 558	55	
" 562	1 10	

Digitized by Google

No. 577	$ 1 32		
" 582	27		
" 590	55		
" 592	2 20		
" 601	68 75		
" 639	55		
" 649	2 20		
" 666	55		
" 675	5 28		
" 676	55		
" 677	55		
" 712	7 04		
" 740	1 32		
" 748	128 20		
" 767	55		
" 769	1 10		
" 782	3 30		
" 784	2 86		
" 811	55		
" 816	55		
" 854	1 10		
" 877	3 08		
" 903	1 65		
" 914	1 87		
" 920	1 32		
" 945	2 20		
" 951	1 10		
" 952	9 07		
" 953	7 10		
" 969	2 20		
" 983	2 20		
" 997	1 90		
" 1014	84 07		
" 1017	10 20		
		267 27	
Total warrants unpaid			$ 451 03
Add amount of time warrants Nos. 1 to 542			3,997 07
Total outstanding indebtedness January 18, 1898			$4,448 10

A discrepancy of four cents exists in the 1896 account which your committee cannot adjust, being unable to refer to old vouchers not in its hands.

Respectfully submitted,

WM. R. BOWEN,

AUSTIN HUMPHREY,

Of the Auditing Committee.

Digitized by Google

On motion, the President appointed as Committee on Resolutions, and to which was referred the portions of both the President's and Secretary's reports not financial, S. C. Bassett, Buffalo county; Elijah Filley, Gage county; P. Youngers, Jr., Fillmore county.

That committee in due time reported as follows, which was adopted:

Mr. President:

Your Committee on Resolutions, to whom was also referred the President's address and report of the Secretary, beg leave to submit their report in the following resolutions:

WHEREAS, The Trans-Mississippi and International Exposition is to be held in the city of Omaha from June 1 to October 31, 1898, and the buildings and other improvements in course of construction and application for space for exhibits already make sure that in beauty and grandeur of grounds and buildings and in the scope and extent of the exposition as a whole, it will rank second only to the great World's Fair held in 1893; and,

WHEREAS, The holding of this great exposition and its attendance by large numbers of people from our own as well as foreign countries will be of great and lasting benefit in the development of the resources of this state,

Resolved, That the Nebraska State Board of Agriculture in annual meeting assembled, is in hearty accord with this great enterprise and hereby pledges every effort in its support and urges like individual effort on the part of every patriotic citizen of the state.

Resolved, That the thanks of this Board are hereby extended to Chancellor MacLean and members of the faculty of the State University for their kindly interest as manifested in the work of this Board, for the valuable assistance rendered in various departments at our State Fairs and on the State Fair grounds, and for the prominence given to the cause of agricultural education in the courses of study in the University, making it true in practice as well as theory that in the University of Nebraska, culture and agriculture go hand in hand.

Resolved, That the President appoint a committee of five on legislation whose duty it shall be to embody in a bill to be presented to our next legislature the views as expressed by our President in his annual address as to appropriations to carry on the work of this Board.

SIGNED.

S. C. BASSETT,
ELIJAH FILLEY,
PETER YOUNGERS, JR.
Committee.

The President appointed the following gentlemen as a Legislative Committee: William A. Poynter, Chairman, Boone county; Robert W. Furnas, Nemaha county; S. C. Bassett, Buffalo

Digitized by Google

county; M. L. Hayward, Otoe county; Austin Humphrey, Lancaster county.

Adjourned to meet again 7:30 this evening.

EVENING SESSION.

The President called to order at 7:30. Quorum present.

REPORT OF BOARD OF MANAGERS.

Mr. Dinsmore, chairman of the Board of Managers, reported as follows, which was ordered to be spread upon the minutes of this Board.

To the Nebraska State Board of Agriculture:

GENTLEMEN—Your Board of Managers make the following report for the year just closed:

In January, 1895, at the annual meeting, parties from Omaha representing the Omaha Driving Park Association and the Omaha Fair Association submitted a proposition for the location of the Fair at Omaha. Among other propositions that they made at that time was that "Railway and motor facilities to the grounds to carry 100,000 people daily. The rate of fare per passenger between Omaha and the fair grounds will be five cents each way on the motor line; the rate of fare between Omaha, South Omaha, and fair grounds by the way of the Missouri Pacific from Webster Street Depot, and via Union Pacific Railway between Union Depot and fair grounds shall not exceed five cents one fare one way, and ten cents for the round trip."

Since the location of the Fair at Omaha there has always been more or less complaint with regard to the facilities for going to and from the grounds. There has never been so many people carried to the grounds during the entire Fair, from all sources, including carriages and foot passengers, as the Omaha people promised to provide facilities for being carried during one day. This has resulted in a material falling off of the receipts of the State Board of Agriculture on account of dissatisfaction on the part of its patrons with the facilities afforded for reaching the grounds and returning therefrom.

For the purpose of showing time consumed by different parties in reaching the grounds, I submit herewith statements made by different parties, of time consumed in the trips between the city and fair grounds, also in some instances between the fair grounds and the city:

STATEMENT.

R. L. Harrison, residing in Grand Island, Hall county, Neb., says: That he was an employe of the State Board of Agriculture at the Annual Fair of 1896. That he used the street railway three times during the fair, and

Digitized by Google

the time it took to make the trip was about one hour. Further that I attempted to get upon the cars at the fair grounds, on Thursday evening, and waited one and one half hours, and then walked into the city, for the reason that I could not get upon the cars. This was the evening of the Ak-Sar-Ben parade.

R. L. HARRISON.

To Whom It May Concern:

This is to certify that the undersigned, a resident of Shelton, Neb., attended the State Fair at Omaha in 1896, and in 1897. That the facilities for getting from Omaha to the Fair grounds were very inadequate in 1896 That on September 1, 1896, I left the grounds for the city at 4:40 P.M., I waited for a car at the gate nearly one hour, and started for the city on foot. I walked about two miles then I caught on to a car and arrived in the city at 10:20 P.M.

On next morning the cars stopped twice and stood so long that some people walked up the hill and caught on when the cars came along; that this delay was of constant occurrence during my stay of four days.

That in 1897, I was at the fair grounds on September 21, 22, 23, and 24. That I always went to the grounds early in the morning and found no trouble in reaching the grounds. That in the evening, I was delayed more or less each time. That in my judgment the fair was injured materially by the want of proper means to get to and from the grounds from the city of Omaha.

E. WYMAN.

Subscribed and sworn to before me for the purposes and use therein stated, this 3d day of January, A.D., 1898.

[SEAL] T. L. GRAFIUS,
Notary Public.

GIBBON, NEBRASKA, December 31, 1897.

This is to certify that the undersigned, a resident of Gibbon, Neb., attended the Nebraska State Fair in the year 1895. That on Monday it required one (1) hour of time to reach the State Fair Grounds from the business center of Omaha. That on Tuesday three and one-half (3½) hours were required to reach said grounds from said center of said city. That the undersigned remained some days in said city and desired to visit said fair, but was deterred from so doing by reason of the time required and annoyance experienced on account of the lack of proper transportation facilities from the city of Omaha to said grounds.

JAMES H. DAVIS.

The undersigned, a resident of Gibbon, Neb., certifies that he attended the Nebraska State Fair in the years 1895 and 1897. That in the year 1895 it took two and one-half (2½) hours of his time to get to the State Fair grounds from the Paxton hotel in the city of Omaha via the street car line, and that he returned to said hotel via the steam car line, it requiring two (2) hours of time.

That in the year 1897 he visited said fair on two days, and that it required one and one-half (1½) hours of time to reach said fair grounds

Digitized by Google

from said Paxton hotel on each occasion, and the same length of time (one and one-half (1½) hours) to return from said grounds to said hotel.

L. N. BABCOCK.

Dated GIBBON, NEB., January 8, 1898.

To you who were present it is needless to say that whenever a demand for transportation became urgent the facilities were inadequate. Many of you from your own experience realize that the time was anywhere from thirty minutes to two hours, and in some instances longer, both going to and from the city, between the hours of 11 A.M. and 9 P.M.; in fact the whole system of street car transportation, as now constructed, is inadequate to meet the wants of the State Board of Agriculture in the accommodation of its patrons in reaching the grounds. After three years' hard work and most diligent effort to make a financially successful fair upon the grounds now occupied, your Board is fully convinced that it cannot be done with present facilities.

There were in attendance upon the fair of 1895 total number of 78,391, for the year 1896, 67,512, being a falling off of 10,879. Both of these years were exceeding unfavorable, owing to the weather at the time of holding the fair. The falling off for the year 1897 was still more marked, when the weather is considered, there being a total number on the grounds of 58,452, being a falling off of 9,060. These figures seem to indicate that it is not within the power of any one to make such an exhibit as shall result in a financial success from a fair held upon the present grounds with existing facilities.

On the 13th of July last the following letter was written to our Secretary:

"OMAHA, NEB., July 13, 1897.

"*Hon. R. W. Furnas, Brownville, Neb.:*

"DEAR SIR—I have been requested by Mr. O. J. Pickard, of this city, to inform you as an officer of the State Board of Agriculture that he has taken possession of the N. W. ¼ of the N. E. ¼ and the N. E. ¼ of the N. W. ¼ section 25, T. 15, R. 12, being the premises leased to the Omaha Fair and Speed Association by himself and others. The Association being in arrears for rent and so possession was taken by virtue of a writ of restitution. Mr. Pickard has no disposition to annoy or harrass the State Board in any manner whatever, and you can doubtless come to some satisfactory arrangement with him in relation to any property which may now be on the premises. I apprise you so that you may take any steps you may think proper. I am, Respectfully yours,

"GEO. O. CALDER."

Immediately on receipt of this letter I telegraphed President Doolittle, asking him to meet me in Omaha, which he did, and we there met Mr. O. J. Pickard, and after an interview of considerable length he informed me that the State Board of Agriculture could have use of the State Fair Grounds for the purpose of holding its fair for the year 1897 by paying the rent due October 1, 1896, amounting to $400 and interest on the same.

Digitized by Google

and securing the payment of the $400 for the year ending October 1, 1897, On the same day we had an interview with Messrs. Bennett, Kelley, Mount, and Clark of the Omaha Fair and Speed Association, and from them and by them were assured that the matter of difference as to the occupancy of the ground between Mr. Pickard and the Omaha Fair and Speed Association and the Nebraska State Board of Agriculture could and would be amicably adjusted, so that the fair could go on without delay or annoyance to your Board.

On the 9th of September, I directed Mr. W. D. Mann, to commence work on the fair grounds for the purpose of having things in readiness for the opening of the fair on the 17th. He went to the grounds, with men for the purpose of commencing work, was met by an officer who ordered him off the grounds, and to cease work, interference, or in any way meddling with the buildings, fences, or grounds known as the Omaha State Fair Grounds. He at once served upon me verbal notice that he had been stopped at work, and at my request furnished the following certificate:

"OMAHA, NEB., September 10, 1897.

"This will certify that I am superintendent of the stores and repairs for the Nebraska State Board of Agriculture; that in the discharge of my duties as such officer, I was by the Board of Managers directed to commence work on the 9th of September, 1897, on the State Fair grounds at Omaha, which I did, and on the 10th of September, 1897, I was ordered off the grounds and to cease work by a constable, who was accompanied by Mr. O. J. Pickard.

"W. D. MANN."

On the same day the Board directed the following communication to Mr. D. T. Mount, secretary of the Omaha Fair and Speed Association:

"OMAHA, NEB., September 10, 1897.

"*D. T. Mount, Esq., Secretary Omaha Fair and Speed Association:*

"DEAR SIR—I am directed by the Board of Managers of the Nebraska State Board of Agriculture to demand of the Omaha Fair and Speed Association, that our Chairman Dinsmore be put in possession of the grounds and buildings in Douglas county, Neb., known as the Nebraska State Fair Grounds by 10:00 o'clock, A.M., of September 11, A.D., 1897, for the purpose of receiving possession of said grounds and buildings as per contract. Mr. Dinsmore will be at the east gate of said grounds, commonly known as the street car gate, at the east of the grand stand at the hour and day above named.

"Respectfully yours,

[SEAL] "ROBT. W. FURNAS,

"*Secretary.*"

This was served upon Mr. Mount upon the same day, as shown by the following certificate:

"I herewith certify the within was served upon D. T. Mount, Secretary of the Omaha Fair and Speed Association, on September 10, 1897, at 6 P.M by leaving with him a true copy of the same. ELI A. BARNES."

Digitized by Google

Mr. Mount acknowledges the receipt of it upon the same instrument, in the following words:

"OMAHA, September 10, 1897.

"Received notice of which this is a true copy.

"D. T. MOUNT,

"*Secretary Omaha Fair and Speed Association.*"

On the following day, September 11, the following letter was received by your Secretary:

"OMAHA, September 11, 1897.

"*Hon. Robt. W. Furnas, Secretary State Board of Agriculture, Omaha, Nebraska:*

"DEAR SIR—I beg to acknowledge receipt of your notice of the 10th inst., and in reply regret to say, that by reason of legal complications arising between Omaha Fair and Speed Association and the land owners who are now in actual possession of the north 80 acres and tract known as the fair grounds, our Association is unable to comply with your demand for possession of the fair grounds and buildings, as per contract.

"Yours respectfully,

"D. T. MOUNT,

"*Secretary.*"

Upon the same day the following permission was received by the chairman of your Board of Managers:

"Permission is hereby given to the Omaha Fair and Speed Association and persons claiming under it to enter upon the tract of land described as follows, to-wit: the northwest quarter (¼) of the northeast (¼), and the northeast quarter (¼) of the northwest quarter (¼) of section twenty-five (25), township fifteen (15), range twelve (12), in Douglas county, Nebraska, for the purpose of making improvements and doing such work as may be necessary for the holding of the State Fair this present month. This permission is not to be considered a waiver or a forfeiture of the lease of said lands hereinbefore entered into between the owners of said lands and the Omaha Fair and Speed Association, but the said forfeiture is to remain unaffected by this permission.

"This permission is further given upon the express condition that the Omaha Fair and Speed Association shall complete the settlement agreed upon between it and the owners of said land by a delivery of $11,696.40 in bonds, and the payment of the sum of $4,240 in cash on or before the 18th day of September, 1897. In case said bonds are not delivered or said money paid on said date, the said Omaha Fair and Speed Association, and all persons occupying said premises under it, shall be treated as trespassers, and shall immediately vacate said premises, and the owners of said lands have the right to evict the said Omaha Fair and Speed Association, and all persons claiming under it, without legal process. This permission is understood to be a mere license, and is not to be considered

Digitized by Google

as a lease or conferring any right of possession whatever upon the Omaha Fair and Speed Association, or any person claiming under it.

"OSCAR J. PICKARD,
"JOHN A. WEAVER,
"A. CLEMENS,
"OMAHA FAIR AND SPEED ASSOCIATION,
"by W. R. BENNETT,
"*President.*"

Your Board never had any other or further notice of permission to go onto the grounds than that just quoted, and found itself to a considerable extent hampered and annoyed by the reason of the delay of work and refusal to allow the work to proceed. Your Board was continually annoyed by the failure on the part of the Omaha Fair and Speed Association to have placed the water supply system on the grounds in adequate repair to meet the demands made upon it. It was not until the third or fourth day after the gates were open to exhibitors that an adequate supply of water was to be had in some parts of the grounds, and through the entire holding of the fair there was more or less annoyance occasioned by reason of the improper condition of the water plant.

At the last annual meeting of this Board, the chairman of your Board of Managers made a report, which is to be found on the bottom of page 45 and on the top of page 46 of the Report of 1896, showing the amount of unsettled claims between the Omaha Fair and Speed Association and this Board to have been $3,033.23. This having been referred to the incoming Board, it was taken up with them and a settlement made with the Omaha Fair and Speed Association for the sum of $2,000, for which a memorandum of indebtedness was given by the Omaha Fair and Speed Association to your Board of Managers. In July last a committee from the Omaha Fair and Speed Association waited upon your Board of Managers and showed to your Board that the property belonging to the Omaha Fair and Speed Association was incumbered by judgments, mechanics' liens, and items being then reduced to judgments, and that they could only save said property by bonding the same in an amount sufficient to cover all incumbrances and provide for the interest and taxes for a year or two; that in order to do so it would be necessary to include the amount due the Nebraska State Board of Agriculture as an ordinary claim, and issue bonds in taking up and caring for the same.

Objection was made that the Board were not authorized by law to buy or deal in securities of the nature contemplated. We were given clearly to understand that unless such an arrangement could be made that there was a strong probability that the Board would not be able to occupy the grounds and buildings, that they would pass from under the control of the Omaha Fair and Speed Association by sale of part of the property and the repossession of other parts by the lessors.

That if the Board would consent to take bonds for their claim, that they, the committee from the Omaha Fair and Speed Association and the Association would, if the finances of the Board demand it, undertake to

Digitized by Google

furnish a purchaser for said bonds at par and in this way relieve the Board of the ownership of bonds if taken. After due consideration a resolution was adopted in substance authorizing the Board of Managers to accept bonds for $2,000 in payment of the last item of indebtedness due by and owing from the Omaha Fair and Speed Association. On the 18th day of September after the fair had opened, a delivery of twenty bonds of $100 each was made by the Omaha Fair and Speed Association to your Board of Managers. After the fair closed, your Board of Managers in an informal way directed its chairman to communicate with the president of the Omaha Fair and Speed Association, and a copy of the letter is herewith submitted.

To this letter Mr. Bennett, on November 20, 1897, made a reply, and which reply is herewith submitted and made a part of this report.

"OMAHA, November 20, 1897.

"*J. B. Dinsmore, Esq., Sutton, Neb.:*

"DEAR SIR—Your favor of November 8, 1897, to me, as President of the Omaha Fair and Speed Association, received, and matter contained therein was read and discussed at our last meeting, Thursday, November 18. I was authorized by the Board of Directors of the Omaha Fair and Speed Association to inform you and the State Board of Agriculture that, as the question of holding the fair in Omaha in 1898 would directly concern the new board of directors of the Omaha Fair and Speed Association, which will be elected December 13, 1897, it was a matter for them to decide; and your letter of above date would be turned over to them for settlement. As to the other question of placing your bonds, it was decided that this was a question that could not be considered by the board.

"Very respectfully,

"OMAHA FAIR AND SPEED ASSOCIATION.

"W. R. BENNETT,

"*President.*"

"SUTTON, NEB., October 22, 1897.

"*W. R. Bennett, Esq., President Omaha Fair and Speed Association, Omaha, Nebraska:*

"DEAR SIR—The fair has now been held in Omaha for three years. There has at all times been more or less complaint on the part of patrons that the facilities to get back and forth from the grounds were poor. The proposition submitted on the part of Omaha at the time the fair was located on its present site stated ample facilities, street car and steam car, would be afforded for the conveyance of 100,000 people per day to the grounds, that a rate of fare upon street and steam railways should be five cents each way. Both of these propositions have failed in compliance. During no fair that has been held in your city in the last three years has there not been 100,000 people all told on the grounds, and for the handling of these in five days the transportation facilities have been inadequate. Further, there has never been on the part of the city of Omaha a sufficiently liberal patronage to justify the statements made at the time

Digitized by Google

of the location of the fair as to what might be expected from the people of that city. When the fair was located in Omaha our treasury had a balance of $4.88 in it. Expenditures were made on the part of the board that they were not expecting to have been called upon to make, and which reduced the balance on hand at the close of the first year to $1,089.93. The weather during the time of holding the first and second fairs was unpropitious in the extreme, and the people failed to respond as liberally during the second fair as they did during the first, and it resulted in a debtor balance at the close of the second year of $1,667.45. It is true that our reports, as published to the world, showed that we had a cash balance of $332.93, but you will remember that yourself and others took up and carried for the Board $2,000 of warrants, which were still a claim against the Association, leaving the real balance as I have stated.

"The third year of the fair was a most magnificent one, so far as the showing made is concerned. The weather could not have been better under any circumstances, but the people failed to attend, the attendance being less than on either of the two years preceding. We are now confronted with a debtor balance of $4,314.74. It is true, to offset this balance we have bonds of the Omaha Fair and Speed Association for $2,000, but so far as I am now able to learn, these bonds have no fixed value. This compels our Board to face a very unpleasant state of affairs. We are thoroughly convinced that a successful fair cannot be held upon the grounds now occupied. It is an "open secret" the facilities for reaching the grounds are so inadequate that people from the city, as well as the country, will not attempt the crush, annoyance, and the unusual expenditure of time in getting to and from the grounds. Since the last fair I have been repeatedly told by people from over the state that they were in Omaha and would gladly have attended had the facilities for reaching the grounds been such that they could have done it in fifteen or twenty minutes and without subjecting themselves to dangerous crushing while in transit. We are fully aware that no street railway company would be justified in extending its tracks the distance necessarily required to have another line reach the grounds for the traffic that would be thereon during the fair; hence we are compelled to adopt the view that no further or better facilities for reaching the grounds will be had during the time remaining covered by our present contract, to-wit: the years 1898 and 1899. We are further confronted with the exposition to be held in 1898. To hold a fair would be a financial loss, and one in 1899 must suffer in its receipts from the effects of the exposition held the year previous. With these facts staring us in the face I am compelled to submit for the consideration of yourself and your Board of Directors the following:

"There must be an agreement in writing on the part of your Board of Directors to release the State Board of Agriculture from holding its fair on the present site during the year 1898; the Omaha Fair and Speed Association to find a purchaser for the bonds of your association held by the Nebraska State Board of Agriculture at their par value, that the funds may be used to reduce the present deficit. A failure to place in my hands

Digitized by Google

a written release as to the fair for 1898, without other conditions, and a cash sale at par of the bonds before the first day of December of the present year will compel me, as chairman of the Board, to call the Board of Managers together and to submit to them the question of declaring forfeited the contract now held with your people.

"I dislike to be thus pointed in my correspondence, but duty compels it.

"Awaiting your answer, I am,

"Respectfully yours,

"J. B DINSMORE."

ACTION OMAHA FAIR AND SPEED ASSOCIATION.

The following preamble and resolution were offered and adopted by a unanimous vote:

"WHEREAS, The Board of Managers of the Nebraska State Board of Agriculture have requested the Omaha Fair and Speed Association to consent that no State Fair shall be held during the year 1898, and that the said State Board of Agriculture be relieved by the said Omaha Fair and Speed Association from the existing contract between them in so far as the same requires the State Fair to be held near the city of Omaha in the county of Douglas in the year 1898, and such request is made because it is believed that the State Fair should not be held during the year 1898 on account of the Trans-Mississippi and International Exposition to be held at Omaha from the first day of June to the first day of November, 1898; now, therefore,

"*Resolved*, That the said request by and on behalf of the said Nebraska State Board of Agriculture be and the same is hereby granted, and that the said Omaha Fair and Speed Association does hereby consent and agree that no Nebraska State Fair shall be held during the year 1898, and that the existing contract between the said parties shall be, and the same is hereby, waived, so far as it requires the holding of a Nebraska State Fair during the year 1898, without prejudice, however, to the said contract in other respects, and especially in regard to the requirement whereby the Nebraska State Fair must be held in the county of Douglas near the city of Omaha, and upon the grounds of this Association in the year 1899, it being expressly understood that the said contract is not, by this action, released, discharged, or in any way cancelled, but that the said State Board of Agriculture is merely hereby relieved from its obligation under said contract to hold the Nebraska State Fair during the year 1898.

"I, E. G. Solomon, Secretary of the Omaha Fair and Speed Association, do hereby certify that the attached copy of preamble and resolution is a correct transcript of the said preamble and resolution adopted at and recorded in the minutes of the meeting of the Board of Directors of the Omaha Fair and Speed Association held on the 23d day of December, A.D. 1898.

"Witness my signature and the seal of said corporation this 14th day of January, A.D., 1898.

[SEAL.] "E. G. SOLOMON, *Secretary*."

Digitized by Google

NOMINATIONS.

The following nominations were made to fill vacancies on this Board: M. Doolittle, Lincoln county; J. D. Macfarland, Lancaster county, S. C. Bassett, Buffalo county; J. B. McDowell, Jefferson county; Charles Mann, Dawes county; M. L. Hayward, Otoe county; J. R. Cantlin, Dodge county; E. L. Vance, Pawnee county; W. R. Bowen, Douglas county; N. Withrow, Merrick county; P. Youngers, Jr., Fillmore county; L. A. Becher, Antelope county; E. McIntyre, Seward county; G. R. Williams, Douglas county; R. N. Wolcott, Merrick county; Jud. Holcomb, Polk county; E. J. Hubbell, Buffalo county; W. R. Mellor, Sherman county; S. M. Barker, Merrick county; L. Morse, Dundy county; M. W. Chappel, Kearney county; F. A. McKay, Hamilton county.

On motion the following Committee on Nominations was made: M. Dunham, Douglas county; W. Watson, Nemaha county; L. K. McGaw, Polk county; E. M. Searle, Keith county; J. B. Dinsmore, Clay county.

To this committee was referred the above list of names, from which to select fifteen persons to serve as members of this Board for two years, and one for the term of one year to fill the vacancy occasioned by the resignation of Mr. Henry.

The committee in due time reported as follows:

LINCOLN, NEB., January 18, 1898.

We, your committee appointed to select the names and recommend the same to fill vacancies on the Board, would recommend the following for two years:

M. Doolittle, North Platte.
S. C. Bassett, Gibbon.
W. R. Bowen, Omaha.
J. D. MacFarland, Lincoln.
M. L Hayword, Nebraska City.
J. R. Cantlin, Webster.
E. L. Vance, Pawnee.
Charles Mann, Chadron.
L. A. Becher, Neligh.
E. McIntyre, Seward.
W. R. Mellor, Loup City.
N. Withrow, Central City.
L. Morse, Benkleman.
T. A. McKay, Aurora.
P. Youngers, Geneva.
To fill vacancy caused by resignation of R. H. Henry, M. W. Chappell, Minden.

MARTIN DUNHAM,
E. M. SEARLE,
L. K. MCGAW,
J. B. DINSMORE,
WM. WATSON, JR.,
Committee.

Digitized by Google

The report of the committee was adopted, and members declared elected as indicated by the report.

The following reports were rendered and accepted:

REPORT OF GENERAL SUPERINTENDENT.

To the Board of Managers Nebraska State Board of Agriculture:

GENTLEMEN—In compliance with section 39 of the By-laws of the Nebraska State Board of Agriculture, I have the honor to report I visited the fair grounds Wednesday, September 15, 1897, and found the grounds in charge of a constable and Mr. Oscar J. Pickard, the owner of part of the grounds, who stated that he had possession and proposed to keep possession unless the Omaha Fair and Speed Association paid him what they agreed to. The Omaha Fair and Speed Association retained possession until Friday morning, September 17, 1897, when Manager Barnes informed me the Board had possession of the grounds and buildings.

It would have very materially advanced all interests in the holding of a successful fair if possession could have been in the hands of the State Board as per contract.

Exhibitors were detained in arranging their exhibits on account of the Board not having possession, particularly agricultural exhibits, as well as manufacturers' and merchant displays. The large exhibition of poultry filled the building, and a tent 50x70 feet was necessary to supply the exhibitors a temporary place for exhibiting the overflow.

The exhibitors of implements and machinery should be required to erect permanent buildings upon the lots assigned them by the Board, for their own convenience and the public.

In selecting class superintendents, great care should be exercised in selecting competent and efficient persons for the different classes. The superintendent of amphitheatre should look after his building in keeping it swept; have a general care of the property under his supervision.

Quarter-stretch arrangements are very satisfactory. Also suitable place for those who desire to camp upon the grounds.

The steam railway facilities for handling the public who come to the fair are ample, to-wit: the F., E. & M. V., Missouri Pacific, and the U. P. railways. The Street Railway Company cannot handle more than one-half of the people who desire to visit the fair. This branch of the transportation service should be very much better than it now is to properly accommodate fair visitors. It took a train forty-five minutes to make the trip from the city to the grounds, or the grounds to the city. Owing to the fact that the grounds are located so far from the city, it takes the visitors too long a time to go or return.

W. H. HARRISON,
General Superintendent.

Digitized by Google

REPORT OF SUPERINTENDENT MATURE CORN EXHIBIT.

BENKELMAN, NEB., January 15, 1896.

To the President and Members of the State Board of Agriculture:

As superintendent of the mature corn exhibit, I submit the following report: I found about fifteen bushels of Nebraska corn dumped on the floor, in barrels, boxes, and rickety shelves in one corner of Manufacturers' building, and was told it was the State Fair Mature Corn Exhibit; and as corn is not much of a crop in Nebraska, thought it was a good place for it, until some farmers came along the second day of the fair and said it was quite a crop where they lived, and that they had sent samples of their growing to this fair for exhibition and premiums, but that they did not recognize it in its present condition, and guessed that they were not in it this time.

There were three professional seed-corn growers interested in the exhibit—one from Kansas, one from Iowa, and one from Nebraska, and I found upon inquiry that for several years they have used the State Fair as an advertising medium for the seed-corn of their own growing, and for half the state of Nebraska their corn would be a damage to the farmer if donated to them to plant, as climatic and soil conditions in the west half of the state are such that the large varieties of corn are not wanted, and I would recommend that the state be divided at the west boundary line of Boyd, Holt, Garfield, Valley, Sherman, Buffalo, Kearney, and Franklin counties, making east and west Nebraska exhibits and premiums offered in lots suitable for the respective divisions.

And I would further recommend that the exhibit have a permanent location in Agricultural Hall, with proper shelf and table room especially adapted for its display, or be abandoned. And I would further recommend that absence of one-half peck shelled corn with the twenty ears should not debar a worthy sample, as farmers are not posted and collectors are lax in giving information. Make the exhibit useful and interesting to every corn grower or discontinue a farce. Nebraska corn growers only should have cash premiums; professionals should be classed and given diplomas.

Respectfully submited,

L. MORSE.

REPORT OF DELEGATE TO AMERICAN SHORTHORN BREEDERS' ASSOCIATION.

Your committee appointed to attend the American Shorthorn Breeders' Association and other kindred live stock associations would respectfully report that I visited Chicago and spent four days attending one or more livestock association meetings; that at all meetings I was cordially received as your representative; that I found the affairs of all associations in a much improved condition from what they were a year ago, and that a much greater interest was evident in livestock circles than for a number of years.

JOHN B. DINSMORE.

Digitized by Google

REPORT OF SUPERINTENDENT OF GATES, NEBRASKA STATE FAIR, 1897, OF ADMISSION BETWEEN 7 A.M. AND 6 P.M.

	RAILROAD COUPONS.											PASSES.						AMPHITHEATRE.				
	B. & M.	M. P.	F. E. & M. V.	C., ST. P., M. & O.	R. I.	U. P.	TOT'L	State fair general.	Concessionaire's tickets.	Mercantile tickets.	Total paid tickets.	Check passes.	Stock coupons.	Complimentary.	Nebraska pioneers.	M. Doolittle.	Total on grounds.	General admission.	Reserved seats.	Special.	Complimentary.	Total.
Monday	118	53	63	48	46	59	387	1075	122	1	1585	89	606	387	.....	39	2706	118	9	1	60	188
Tuesday	412	134	294	319	154	358	1671	4534	180	15	6400	290	942	853	290	19	8704	950	48	127	129	1254
Wednesday	1159	540	990	521	339	864	4413	6730	182	18	11343	454	1176	1090	.....	9	14072	2553	196	230	248	3227
Thursday	2311	1364	1827	1091	809	1390	8292	14890	202	60	23444	1180	1369	1636	.....	4	27633	4500	507	376	201	5584
Friday	285	127	157	152	43	174	888	1913	92	11	2904	468	1140	818	.....	7	5837	463	44	14	6	597
Totals	4285	2218	3331	2131	891	2845	15651	29142	778	105	45676	2391	5233	4784	290	78	58852	8579	804	748	714	10845
1896 Totals	3578	1925	3171	1733	339	2733	18479	37064	1491	154	52182	2557	5295	7221	257	...	67512	5671	814	487	594	7566

E. M. SEARLE, *Superintendent of Gates.*

Digitized by Google

REPORT OF DELEGATE TO THE AMERICAN ASSOCIATION OF FAIRS AND EXPOSITIONS.

To the Nebraska State Board of Agriculture:

As your delegate to the American Association of Fairs and Expositions, I report that the Association met in Milwaukee in November last for usual conference and consultation. The meeting was well attended and of unusual interest.

Fair dates for 1898 were agreed upon to be

New York	August 22 to 27.	
Ohio	August 29 to September 3.	
Michigan	September 5 to 10	Minnesota
Indiana	September 12 to 17	Iowa
Wisconsin	September 19 to 24	Nebraska
Illinois	September 26 to October 1.	
St. Louis	October 3 to 8.	

The meeting for 1898 will be held at Omaha during the Trans-Mississippi Exposition, the date to be fixed hereafter by the President and Secretary.

Officers for the current year: Robt. W. Furnas, President, Brownville, Neb.; A. J. Lovejoy, Vice President, Roscoe, Ill.; Jas. W. Fleming, Secretary, Columbus, O.; W. M. Liggett, Treasurer, St. Paul, Minn.

Respectfully submitted,

ROBT. W. FURNAS,

Delegate.

REPORT OF COMMITTEE IN MOORE SUIT.

President and Members of the State Board of Agriculture:

GENTLEMEN—We, your committee empowered by the Board of Managers to look after the defense in the suit of Henry N. Moore vs. State Board of Agriculture, brought in county court of Seward county, Nebraska, would report that during the present year the case was tried to a jury and verdict rendered against the Nebraska State Board of Agriculture. An appeal was taken to the district court of Seward county, and the case tried (on Friday, 11th of December) to a jury, and later a verdict in favor of the Nebraska State Board of Agriculture was handed into court, thus ending the litigation and sustaining the contention of the Board in every particular.

While in attendance upon the court, your committee, together with the Treasurer of the State Board of Agriculture, were served with summons in two cases then commenced in Seward county, one the Standard Horse Breeding Company vs. The State Board of Agriculture in justice's court, for a balance of 45 per cent of the amount awarded them on premiums for the year 1897 and remaining unpaid; the other, Frank Iams, in the district court of said county. The first of these suits is for a balance for and unpaid on premiums earned in the year 1897; the other is for premiums

Digitized by Google

alleged to have been awarded at the fair in 1894, and which your committee are informed and believe the books do not show the premiums were awarded him in said year.

Since writing the above, we are informed that the service in the case of the Standard Horse Breeding Company has been disposed of by the quashing of the service had in the case.

J. B. DINSMORE,
ELI A. BARNES.

RECOMMENDATIONS OF BOARD OF MANAGERS FOR THE YEAR 1896.

Your Board of Managers submit the following recommendations for the continuance of the State Board:

1. That no State Fair be held in the year 1898.
2. That no salaries be paid any officer of the State Board for the year 1898.
3. That the sum of $600, or so much thereof as may be necessary, be and is hereby set aside for postage, stationery, typewriter and other necessary expenses of the Secretary's office for the year 1898.

The above was adopted.

Board adjourned until to-morrow morning, 9:30.

LINCOLN, NEB., January 19, 1898.

Board convened pursuant to adjournment. Roll call. Quorum present.

On motion the Board proceeded to election of officers for the ensuing year, W. D. Kelly, of Madison county, L. Morse, of Dundy county, acting as tellers. The result was the election of Milton Doolittle, president, North Platte; J. N. Van Dyne, first vice president, Wilber; L. A. Becher, second vice president, Neligh; Ed. McIntyre, treasurer, Seward; R. W. Furnas, secretary, Brownville.

The case of O. P. Hendershott, an appeal from the action of the Board of Managers in the matter of awards in the Saddle Horse Lot, Speed class, fair 1897, was taken up. After considerable debate the action of the Board of Managers was sustained. The award was made by the judges: first, to Miss Mae Mount, and second and third to O. P. Hendershott.

The President appointed the following Board of Managers for the year 1898: S. C. Bassett, Gibbon, chairman; W. A. Poynter, Albion; J. B. Dinsmore, Sutton; W. R. Bowen, Omaha; Austin Humphrey, Lincoln.

Digitized by Google

The appointments were confirmed by a vote of the Board.

President Doolittle was appointed delegate to the Denver Live Stock Convention with power to name an alternate in case he could not attend.

Adjourned *sine die*.

MILTON DOOLITTLE,
President.

R. W. FURNAS,
Secretary.

NATIVE GRASSES.

The collections of native Nebraska grasses exhibited at the Fair of 1897 were:

NAME OF EXHIBITOR	RESIDENCE.	COUNTY	NO. OF VARIETIES.
F. E. Noyce	Irvington	Douglas	39
C. E. Drake	Albion	Boone	106
L. L. Cowles	Valley	Douglas	66
J. H. Taylor	Waterloo	Douglas	152
W. Cachlin	DeSoto	Washington	147
Cecil Pen	Hebron	Thayer	124
M. Robins	McCool Junction	York	102
Charles Graw	Bennington	Douglas	52
R. W. Douglas	Elkhorn	Douglas	55
William James	Pleasant Hill	Saline	108
H. V. Parsons	Central City	Merrick	28
B. F. Pitman	Chadron	Dawes	20
L. W. Parsons	Max	Dundy	59
John Grevis	Nashville	Frontier	55
E. Johnson	Lexington	Dawson	39
R. Groms	Valentine	Cherry	17
E. Smith	Bodarc	Sioux	78
George Roberts	Creighton	Knox	52
Thad. Robinson	Minden	Kearney	83
John Mills	Geneva	Fillmore	61
Frank Peterson	Bancroft	Cuming	64

Digitized by Google

SCORE OF COUNTY COLLECTIVE EXHIBITS.

The following is the Official Score of County Collective Exhibits, Nebraska State Fair, 1897.

THE SCORE AND AWARDS ON COUNTY COLLECTIVE EXHIBITS AT THE NEBRASKA STATE FAIR AT OMAHA, NEBRASKA, SEPTEMBER 17-24, 18 7—POSSIBLE SCORE 1600 — PRO RATA PREMIUMS ON $2500 on POINTS OVER 800.	Money appropriated $3000 — $500 to county scoring highest.	Nebraska Farmer special premium—No. yearly subscriptions.	Corn.	Wheat.	Oats.	Barley.	Rye.	Other varieties of grain.	Native grasses and other forage plants.	Tame grasses, including millet.	Potatoes.	Onions.	Cabbage and beets.	Squashes, melons, and pumpkins.	Grain in the sheaf.	Miscellaneous.	Taste in display and arrangements.	Greatest number of varieties.	Total number of points scored.
Washington	$ 500 00	100	91	87	85	79	79	81	84	84	83	83	81	81	85	86	87	100	1356
Saline	225 41	90	88	90	78	81	81	68	78	84	85	85	83	84	82	78	95	83	1318
Thayer	211 48	80	83	77	76	78	64	74	83	82	78	82	78	87	81	81	92	90	1286
Boone	211 06	70	80	83	79	79	73	82	82	77	86	83	79	83	81	78	86	74	1285
Cuming	209 30	60	89	78	80	79	78	74	78	83	84	68	72	83	77	83	84	82	1281
York	182 78	50	83	82	81	73	52	71	84	82	79	81	70	80	73	81	79	69	1220
Kearney	180 59	40	79	77	70	69	73	60	77	74	75	80	73	76	76	86	86	84	1215
Furnas	142 82	30	78	87	72	70	67	70	67	72	68	65	69	68	80	75	84	35	1127
Gage	141 88	20	81	73	70	67	50	48	72	78	65	73	72	80	72	77	82	66	1126
Fillmore	139 28	10	87	83	77	60	65	47	77	73	71	66	67	70	76	77	84	40	1120
Dundy	124 92	.....	73	75	66	76	67	48	77	72	72	68	67	70	67	70	79	40	1087
Red Willow	107 53	.....	77	82	60	68	64	47	60	67	70	71	67	70	63	63	78	40	1047
Nuckolls	106 65	.....	76	71	76	72	59	48	67	65	71	74	62	67	76	69	56	36	1045
Frontier	105 35	.....	77	79	63	48	58	42	77	74	68	63	60	68	74	70	86	35	1042
Dawes	104 47	.....	70	65	68	73	71	.....	81	80	79	71	69	73	77	69	62	32	1040
Dawson	100 56	.....	75	54	43	43	53	58	63	70	69	63	71	72	79	80	78	60	1031
Knox	87 51	.....	73	73	70	50	62	.....	76	72	82	67	66	67	60	70	77	36	1001
Merrick	87 08	.....	80	78	70	70	65	.....	62	72	75	57	59	74	67	72	74	27	1000
Sioux	81 83	.....	60	63	45	.....	.....	.....	74	73	76	81	72	73	62	77	74	43	873
Hitchcock	.....	.....	70	82	58	55	57	00	40	58	58	45	57	40	57	47	50	13	787
Brown	.....	.....	68	57	42	40	56	.....	57	42	67	50	62	65	48	52	67	15	778
Cherry	.....	.....	53	53	45	55	45	.....	58	58	56	46	62	70	38	60	63	15	777
Rock	.....	.....	65	50	.....	.....	.....	.....	43	58	52	47	53	55	33	35	46	10	552

Digitized by Google

THE APIARY IN NEBRASKA.

As a sample of the bee and honey industry in Nebraska the two reports following are presented as per work 1897:

FROM WILLIAM STOLLEY.

GRAND ISLAND, HALL COUNTY.

COMB HONEY.

COLONY NO. 1.

CYPRIAN QUEEN.—Age June, 1896 (—).

This colony wintered in three brood sections of the new Heddon hive, packed in a vault with dry, soft maple leaves on October 23, 1896, and had a little over forty pounds of winter stores at the start.

On May 4, 1897, I put on a surplus section case with nine (9) sections, with unsealed honey to stimulate.

May 20. I broke the cappings of the upper brood section and placed it below the other two sections containing all the brood, and at the same time I put on the first section case with drawn comb in the sections.

June 6. This colony swarmed. All brood sections were removed to a new stand, and two (2) entry brood sections, with drawn comb, were put on the old stand, next a queen excluding board, and then the surplus section case was returned when the swarm was hived on the old stand.

June 27. I removed the section case, with the previously drawn comb, from this hive and replaced it by a new surplus with new sections filled with full sheets of surplus comb-food.

July 23. The first surplus was nearly capped, the second surplus in process of capping, and the third surplus was put on for want of room; each surplus holding twenty-eight sections, 1⅞x4¼x4¼.

On July 30, 1897, I took off twenty-eight sections fully capped.

On August 3, 1897, I took off twenty-eight sections fully capped.

On September 15, 1897, I took off sixteen sections fully capped, and also twelve sections but partly capped over. I estimate the stores in the two brood chamber sections to contain at least twenty pounds. Total, seventy-two sections capped, twelve uncapped.

The crop realized from this colony is melilot with a slight admixture of alfalfa honey.

I hereby verify that the above account of the colony of bees in question is true and correct to the best of my knowledge and belief.

WM. STOLLEY.

Subscribed in my presence and sworn to before me, this 16th day of September, A.D., 1897.

JOHN ALLAN,
Clerk District Court Hall County, Neb.

By HENRY ALLAN, *Deputy.*

Digitized by Google

FROM WILLIAM STOLLEY.

GRAND ISLAND, HALL COUNTY.

EXTRACTED HONEY.

COLONY No. 21.

ITALIAN QUEEN.—Age June 18, 1896.

October 16, 1896. This colony was packed in a double-walled hive. Capacity of hive, twelve frames, 11⅛x11⅛, but was contracted to nine combs, containing thirty pounds of winter stores, covered with a woolen quilt and bag of oats chaff.

March 10, 1897. One empty comb was replaced by a comb containing about four pounds of honey (had in a two combs' brood at that date).

May 4. I gave two combs, containing about six pounds of honey, and clipped the wings of the queen. At this time I found six combs well stocked with brood.

May 19. I transferred the colony out of the double-walled hive into a dove-tailed, single-walled, summer hive, of twelve frame capacity, and gave one more comb containing four pounds of honey.

May 20. First surplus, with extracting comb, was put on to give more room to accumulating bees.

June 1. This colony had eleven combs full of brood, and but very little honey. Second surplus was put on.

June 15. I shaved off the heads of all drone brood I could find, which was again repeated on June 22, when, also, the body of the hive was raised by putting blocks under it about one-half inch from the bottom board, so as to give the needed ventilation for the overcrowded bees.

July 6. Both surplusses were full, but very little capped, so the third surplus was put on, supplied with extracting combs—half depth of brood combs.

July 15. I extracted forty-four pounds pure melilot honey, and gave fourth and fifth surplus with extracted sapor combs.

August 3. I took forty-four pounds of extracted honey, and gave one more surplus with extracted combs.

September 14. There are at least thirty-five pounds of extracted honey in the surplusses, and fully twenty-five pounds of early in the season gathered winter stores. A total product of 123 pounds extracted surplus and twenty-five pounds of stores to winter on. Total 148 pounds.

I never extract from brood chambers. The two last takings of surplus was slightly mixed with alfalfa honey.

I hereby verify that the above account of the colony of bees in question is true and correct to the best of my knowledge and belief.

WM. STOLLEY.

Subscribed in my presence and sworn to before me this 16th day of September, A. D., 1897.

JOHN ALLAN,
Clerk District Court, Hall County, Neb.

By HENRY ALLAN, *Deputy.*

Digitized by Google

FROM C. M. LEWELLING.

BEAVER CITY, FURNAS COUNTY.

I hereby submit the following report of hive No. 11 in my Apiary, located at Beaver City, in Furnas county, Neb., in competition for premium No. 1392 of your Premium List for 1897.

No. 11 is a colony of pure Italian bees, quite yellow in color, gentle to handle and energetic workers.

Their queen was raised in a full strong colony of bees in July, 1896.

She is above the medium in size and very yellow in color.

This colony began breeding early in the spring of 1897, and to stimulate them in breeding, I, in the last part of April, began to feed them syrup made by combining equal parts by measure, of granulated sugar and water, which I stirred until the sugar was all dissolved. I fed nearly one pint of the syrup twice each week (in a simplicity feeder) for six weeks, when they began to gather nectar from alfalfa, when I quit feeding.

The hive used for this colony of bees is a ten frame, two story, double walled hive, with oats chaff packed between the walls. The lower story holds ten brood frames. The upper story will hold fourteen brood frames for extracting, or it will hold eighty sections 4¼x4¼x1⅞ inches for comb honey.

On June 6 I found this colony storing honey from the fields quite freely in the upper edges of the brood frames, eight of which were well filled with brood in all stages of maturity.

I also found they had a number of queen cells started and an egg in each of them.

I immediately destroyed the queen cells and placed in the upper story of the hive seventy-two 4¼x4¼ sections with a starter of their foundation about one inch wide in each section.

September 13, I looked through this hive again, and found them at work in the sections and also that they had not started any more queen cells.

July 16, I opened hive again and removed 28 pounds of comb honey. I found upon examination that the bees had stored so much honey in the brood chamber that the queen was short of room to deposit eggs. I therefore took two of the outside brood combs and extracted 7½ pounds of honey therefrom and placed them in the center of the brood chamber, replacing the filled sections which I had removed with empty sections and starters as before.

On August 4 I removed from this hive 68 pounds of beautiful comb honey in the sections, and again finding the queen cramped for room I extracted 10½ pounds of honey from three of the brood frames and placed them in the center of the brood chamber, placing sections with starters on the hives as before.

On September 8 I took 70 lbs. of comb honey, but as the queen had plenty of room for brood I did not extract any from the brood chamber, but placed sections with starters on the hive as before.

Digitized by Google

On September 15, I opened the hive and found the sections full of bees at work. On this date I started for the state fair and can give no further report at this time.

I have taken from this hive in all, 184 pounds, of which 18 pounds was extracted and 166 pounds was comb honey in sections. Nearly all was gathered from alfalfa, and the quality of the honey was the very best.

OMAHA, NEB.

DOUGLAS COUNTY, }
STATE OF NEBRASKA. } ss.

Subscribed and sworn to this 20th day of September, 1897.

W. E. DAVIS,
Notary Public.

Digitized by Google

DAIRY DEPARTMENT.

SCORING RECORDS AT STATE FAIR, 1897.

SEPARATOR AND GATHERED CREAM BUTTER.

MINIMUM NUMBER OF POINTS, 92.

	Score in points
I. M. Schwoub, Craig	90
Seward County Creamery, Seward	92
A. E. Olander, Oakland	95
C. F. Schwager, Battle Creek	96
Albion Creamery Co., Albion	97½
W. Z. King, Norfolk	93
Raymond Creamery Co., Raymond	94
Hadley & Place, Cedar Rapids	93½
J. J. King, West Point	96
W. W. Ladd, Albion	97½
James Hain, Albion	97½
St. Edwards Creamery Co., St. Edwards.	91
H. Johnson, Logan, Ia	91½
Caledonia Creamery Co., Pauline, Ia	97

SEPARATOR BUTTER AND NOT SEPARATOR.

MINIMUM POINTS, 90.

H. Johnson, Logan, Ia	96½
C. W. M. Poynter, Albion	96
H. C. Glinman, Omaha	91
Mrs. L. Jensen, Omaha	93
R. W. Douglas, Elkhorn	93

FARM DAIRY BUTTER.

MINIMUM POINTS, 95.

W. W. Ladd, Albion	97½
H. Johnson, Logan, Ia	96½

FULL CREAM CHEESE.

MINIMUM POINTS, 90.

M. H. Manley & Co., Arizonia	95½
A. F. Hartwell, Inavale	94½
J. F. Thompson, Burchard, Ia	93

FARM AND DAIRY CHEESE.

MINIMUM POINTS, 85.

J. B. Manley, Tekamah	95½

FACTORY CHEESE.

MINIMUM POINTS, 90.

M. Manley & Co., Arizonia	95½
A. F. Hartwell, Inavale	94½
J. F. Thompson, Blanchard	93

FACTORY AND FARM DAIRY CHEESE.

MINIMUM POINTS, 97.

J. B. Manley, Tekamah	95½

BEST CHEESE.

MINIMUM POINTS, 97.

M. Manley & Co., Arizonia	95½
J. B. Manley, Tekamah	95½

OWNER'S NAME.	NAME OF COW.	Pounds of butter fat.	Pounds skimmed milk.	Value of butter fat at 25 cents per pound.	Value of skimmed milk at 15 cents per cwt.	Total value butter fat and skimmed milk.
	Pure Bred Cows.					
C. F. Stone	Maryke 3d's Gerben	4.11	117.9	$1.028	$0.176	$1.204
C. F. Graves	Ida's Dream 2d	3.70	77.9	.925	.117	1.042
Hudson & Foster	Flossie	3.33	120.8	.834	.181	1.015
Wm. H. McCall	Aggie Mechtchilde	3.37	99.4	.843	.149	.992
C. F. Stone	Empress Josephine Mechtchilde	3.32	101 9	.831	.152	.983
C. F. Graves	Rose Kenlock	3.53	56.7	.883	.085	.968
Wm. H. McCall	Lutske Isabell	2.90	94.2	.725	.141	.866
Hudson & Foster	Vesta McThilda	2.84	100 1	.711	.150	.861
Hudson & Foster	Nellie H	2 75	87.1	.684	.130	.814
C. F. Stone	Empress Josephine 3d	2.73	88.4	.681	.132	.813
C. F. Stone	Princess Pal Mechtchilde	2.70	89.7	.675	.135	.810
C. F. Graves	Hallie Kenlock	2.70	44.5	.676	.066	.742
	Grade Milch Cows.					
Mrs. A. B. Lathrop	No name	2.48	26.8	.620	.04	.66
Harvey Johnson	Tamer	2 30	51.2	.575	.077	.652

Digitized by Google

STATISTICAL REPORT FOR THE YEAR 1897

COUNTIES	REAL ESTATE—LANDS							HORSES.			CATTLE.		
	IMPROVED.			UNIMPROVED.			Assessed valuation of property.						
	Acres.	Value	Av.	Acres.	Value.	Av.		No.	Value.	Av.	No.	Value.	Av.
Adams	276774	$994561	$ 3 59	63187	$103098	$ 1 63	$ 2645583 77	8992	$53891	$ 5 99	12980	$56082	$4 32
Antelope	184826	441977	2 39	321097	390636	1 22	1471238 22	7486	58028	7 75	14284	83669	5 88
Banner	* 247639	185729	75				253814 00	3020	10707	3 54	7530	39867	5 29
Blaine	2449	5603	2 28	67866	103566	1 52	186601 42	675	3145	4 66	2627	9559	3 63
Boone	290542	728524	2 51	105381	171580	1 62	1558444 20	7656	60615	7 91	17297	91395	5 28
Box Butte	80000	62500	78	480000	288760	60	693253 50	3808	15032	3 98	10053	41059	4 08
Boyd	* 44208	91189	2 06				216843 00	4880	34662	7 10	5822	31593	5 42
Brown	75861	139085	1 83	122891	135633	1 10	543024 31	2748	15501	5 64	4592	26722	5 82
Buffalo	535182	1226938	2 29	30689	42710	1 39	2875276 21	13282	84656	6 37	17478	58577	3 35
Burt	216542	1534948	7 08	71572	357482	4 99	2779011 00	8015	51818	6 46	21878	145286	6 63
Butler	274284	967819	3 53	76157	194385	2 55	2113764 50	9132	40852	4 47	20548	58883	2 87
Cass	* 337159	2065205	6 14				4183447 27	9694	77779	8 02	15187	77038	5 07
Cedar	217369	784382	3 60	199942	563592	2 82	1953200 40	9016	40175	4 45	22386	64448	2 88
Chase	96646	144969	1 50	289988	306203	1 05	588737 20	2582	10803	4 18	8081	22941	2 83
Cherry	62909	86185	1 37	323331	313612	97	1285617 61	10565	54515	5 16	49772	278248	5 49
Cheyenne	28540	89135	3 78	754156	457114	63	1189015 87	7100	26128	3 68	17200	93740	5 45
Clay	302880	963738	3 18	43069	100127	2 32	2346707 77	10195	58736	5 76	12086	57077	4 72
Colfax	* 247145	1204514	4 87				1909853 51	5570	51034	9 16	16192	70445	4 35
Cuming	328563	1769298	5 39	13924	61965	4 45	2618123 34	7548	51906	6 88	28593	123215	4 31
Custer	400324	611871	1 52	806859	706078	87	2068031 06	19958	92584	4 64	28340	112738	4 00
Dakota	122000	719800	5 90	26600	81397	3 06	1460006 00	3917	22016	5 62	9865	39277	3 98
Dawes	* 486574	420389	86				1170420 11	7661	36275	4 74	13855	64471	4 65
Dawson	310875	484820	1 52	273678	313957	1 14	1647438 45	10929	55609	5 08	14717	32956	2 24
Deuel	84460	46314	1 84	349156	382478	1 09	762180 10	3776	9353	2 47	19252	45159	2 34
Dixon	166619	581612	3 48	112115	326718	2 91	1596853 70	6125	52610	8 59	15819	78190	4 94
Dodge	231971	1001884	4 31	92285	319052	3 46	3059216 84	7950	78133	9 82	25228	105798	4 11
Douglas	157586	1927468	12 23	29745	973140	32 71	21070978 92	10128	93914	9 27	11605	65184	5 61
Dundy	50594	69907	1 38	254641	242111	95	582684 42	2918	12016	4 12	4723	22632	4 79
Fillmore	310098	1290275	4 16	45726	131089	2 86	2580146 46	9769	57079	5 84	11262	49454	4 39
Franklin	164832	357905	2 17	177028	232898	1 31	1015343 80	6515	31698	4 86	11438	43657	3 82
Frontier	197287	490776	2 48	332447	280978	81	1105515 20	9090	44587	4 90	8595	37089	4 31
Furnas	290291	558342	1 92	131110	350482	2 67	1515194 42	10035	59371	5 92	13866	48396	3 24
Gage	489121	2383398	4 87	25478	96268	3 78	4978645 85	14578	103550	7 10	27875	144838	5 20
Garfield	20886	50141	2 40	77888	117935	1 51	289304 80	1578	7705	5 59	2265	13533	5 97
Gosper	159330	370491	2 32	112712	150119	1 33	719870 20	5342	28375	5 31	7471	28221	3 78
Grant	* 28640	37480	1 31				238422 95	1489	9327	6 26	13668	69346	5 07
Greeley	87248	194082	2 22	228968	411761	1 79	924037 80	3791	29499	7 78	5758	22444	3 89
Hall	250652	921459	3 67	70732	159448	2 25	2517393 07	8179	48795	5 60	19560	74726	3 82
Hamilton	280533	785493	2 80	47699	94484	1 98	1579889 66	9032	50881	5 63	17018	71049	4 17
Harlan	179438	381829	2 13	158597	268330	1 69	1258162 76	7447	41898	5 62	9514	42781	4 50
Hayes	* 331469	468658	1 39				557025 60	3274	10208	3 12	5438	19271	3 54
Hitchcock	175018	305818	1 74	201241	282246	1 40	931465 07	4614	21823	4 73	4424	19749	4 67

Digitized by Google

Holt	155527	269575	1 73	976424	1610696	1 65	2543973 90	8990	37000	4 12	27252	87355	3 20
Hooker	357	158	44	11512	5623	48	104907 51	317	998	3 14	686	2515	3 66
Howard	229678	481596	2 09	95770	185757	1 93	1264628 60	5998	36827	6 13	12657	49344	3 89
Jefferson	224509	978237	4 35	125559	254648	2 02	2541637 08	9881	53817	5 68	16141	78728	4 56
Johnson	234014	1249263	5 34	333	1813	5 44	2003599 54	6377	46557	7 30	11379	67142	5 90
Kearney	246658	498224	2 02	59274	65963	1 11	1301653 82	7501	48987	6 53	11196	48136	4 29
Keith	* 422907	380913	93	.....	.....	.....	857343 06	2363	7622	3 22	7481	22449	3 00
Keya Paha	* 292466	327583	1 12	.....	.....	.....	434199 00	3196	20570	6 44	8999	49528	5 50
Kimball	* 358494	265109	73	.....	.....	.....	646657 05	1693	4233	2 50	2337	8179	3 50
Knox	187689	552608	2 94	295002	599673	2 03	1721580 20	9001	63686	7 07	18021	71201	3 95
Lancaster	365071	1746647	4 78	120834	442054	3 66	9326225 19	15384	83184	5 73	22857	106286	4 64
Lincoln	164917	307065	1 86	899716	942095	1 04	2559833 13	12046	45025	3 73	15 67	60486	3 86
Logan	* 101940	159050	1 56	.....	.....	.....	207427 00	1426	6863	4 81	3094	10217	3 30
Loup	20107	60223	2 99	59321	67451	1 13	170573 00	1314	11486	8 74	1237	10296	8 32
Madison	214545	837259	3 90	126665	318816	2 55	2181876 84	8402	51695	6 15	21146	87535	4 14
McPherson	* 68420	88020	1 28	.....	.....	.....	106229 00	639	1676	2 62	4690	15178	3 23
Merrick	171246	532171	3 10	111356	256771	2 30	1708657 99	6145	40517	6 59	19651	87716	4 46
Nance	175177	558729	3 19	106180	248800	2 34	1236688 00	6113	36198	5 92	15192	60956	4 01
Nemaha	244547	1298340	5 31	3766	12000	3 18	2315148 78	8559	67994	7 94	11221	56919	5 07
Nuckolls	256275	806238	3 14	83992	246010	2 93	2141577 20	8040	56056	6 97	15628	78826	5 04
Otoe	382026	2755933	7 21	406	1790	4 40	4666409 89	10339	86373	8 35	18002	82602	4 58
Pawnee	157666	906135	5 74	105044	423277	4 03	2382502 55	7402	61953	8 36	17386	97271	5 58
Perkins	* 46591	464841	99	.....	.....	.....	671903 00	2154	7047	3 27	3389	11182	3 28
Phelps	271205	621735	2 29	48775	63559	1 30	1218122 82	8551	37799	4 42	12220	42577	3 48
Pierce	154379	503858	3 26	172327	461847	2 67	1404297 30	5399	28589	5 30	12447	41021	3 29
Platte	301479	912001	3 02	106259	213148	2 00	2347621 35	9646	82309	8 53	22400	83031	3 70
Polk	* 261610	792763	3 03	.....	.....	.....	1223810 50	7825	68515	8 75	16202	43109	2 66
Red Willow	218334	326118	1 49	193211	204048	1 05	1115345 09	7120	31341	4 40	8749	27764	3 15
Richardson	297548	1599973	5 37	34283	89725	2 62	3190231 99	10459	75190	7 18	24133	125795	5 21
Rock	* 242987	354689	1 45	.....	.....	.....	528550 59	2597	12228	4 71	7644	38912	5 09
Saline	323824	1148582	3 53	33177	67569	2 03	2423723 52	10810	61122	5 65	15032	61130	4 06
Sarpy	141097	1121536	7 95	6875	24370	3 54	2127519 31	4757	43166	9 18	7526	47401	6 29
Saunders	* 463641	1599092	3 44	.....	.....	.....	3190132 60	12286	102474	8 34	26474	140472	5 30
Scott's Bluff	* 156432	183473	1 17	.....	.....	.....	334087 00	3139	22193	7 07	5298	57483	10 85
Seward	* 354887	1507384	4 24	.....	.....	.....	2417942 85	9989	65644	6 57	16167	64461	3 98
Sheridan	* 504258	554427	1 09	.....	.....	.....	1197978 68	8624	44136	5 11	23933	142590	5 95
Sherman	* 332597	520569	1 56	.....	.....	.....	849132 52	5102	22951	4 50	7854	27825	3 54
Sioux	25928	44130	1 70	181785	149271	1 13	527518 49	4757	33162	6 97	15012	87775	5 84
Stanton	149151	566842	3 80	126079	417873	2 31	1359070 91	4853	33487	6 90	18485	76188	4 13
Thayer	288129	1046190	3 63	62411	170200	2 72	2157098 20	8858	59896	6 76	12279	63187	5 14
Thomas	6051	6053	1 00	14389	8309	58	129094 00	332	1870	5 63	688	2276	3 30
Thurston	* 18500	125749	6 79	.....	.....	.....	411796 60	3673	31713	6 83	7289	38878	5 33
Valley	127708	294195	2 30	201675	248857	1 23	899517 80	5670	24300	4 29	9672	33959	3 51
Washington	* 236249	1473893	6 24	.....	.....	.....	2427026 60	6910	25383	5 65	15098	71136	4 71
Wayne	223840	950072	4 24	31373	109805	3 18	1715949 00	6886	64803	9 41	18968	78956	4 16
Webster	222239	578445	2 60	108310	214155	1 98	1525250 10	7756	45293	5 83	15438	61033	3 95
Wheeler	12776	19350	1 51	155246	174917	1 12	259185 40	1372	9049	6 59	3596	26900	7 48
York	296637	1065847	3 59	55759	88446	1 58	2146767 03	10633	58708	5 52	15606	79140	5 09
	19541807	$61376395	$3 14	11178717	$18018213	$1 61	$165198736 42	610838	$3773994	$6 17	1228906	$5478928	$4 46

*Improved and unimproved.

Digitized by Google

STATISTICAL REPORT FOR THE YEAR 1897.—*Continued.*

COUNTY.	MULES AND ASSES.			SHEEP.			HOGS.			AGRICULTURAL IMPLEMENTS AND TOOLS.
	No.	Value.	Av.	No.	Value.	Av.	No.	Value.	Av.	
Adams	707	$ 4195	$ 5 91	118	$ 60	$ 50	24573	$ 17936	$ 73	$ 14432
Antelope	327	2399	7 34	735	371	50	25580	32289	1 26	12559
Banner	59	292	4 95	6187	4748	76	228	256	1 12	858
Blaine	41	237	5 79	51	58	1 13	549	754	1 37	852
Boone	496	3791	7 64	1379	1097	80	24697	30302	1 24	12882
Box Butte	93	413	4 44	10923	6313	57	410	451	1 10	2314
Boyd	224	1972	8 80	1275	836	65	6034	8334	1 37	8996
Brown	164	1037	6 32	3142	2372	75	1743	2343	1 35	2632
Buffalo	800	4857	6 07	15933	7182	45	28991	21642	74	15502
Burt	811	5319	7 29	391	205	52	35241	50266	1 42	15614
Butler	645	3010	4 67	1926	448	23	30589	20432	66	9988
Cass	1137	8859	7 79	229	158	69	34421	42617	1 23	18530
Cedar	474	2076	4 38	547	310	56	29288	19123	65	14187
Chase	131	560	4 27	537	304	56	1817	2342	1 28	2462
Cherry	165	1519	5 73	12143	6800	56	1172	1324	1 13	5975
Cheyenne	150	817	5 45	5000	4000	80	640	512	80	3740
Clay	665	3869	5 82	792	399	50	31486	34833	1 08	16657
Colfax	290	2640	9 10	6652	3858	58	21219	20520	90	10000
Cuming	639	4380	6 85	3174	2261	71	40150	40211	1 00	15787
Custer	1134	5434	4 97	425	132	31	36961	40946	1 10	22127
Dakota	240	1304	5 43	9	9	1 00	11009	11554	1 04	4234
Dawes	124	642	5 17	11423	5705	50	1108	581	52	4295
Dawson	539	2408	4 46	519	229	44	29717	15721	52	13211
Deuel	45	148	3 24	3308	827	25	525	132	25	1388
Dixon	333	2848	8 55	178	98	55	15733	19601	1 24	5925
Dodge	483	4261	9 84	3209	1669	52	27987	28734	1 03	10411
Douglas	732	6085	8 31	2451	1375	56	13970	16358	1 17	22162
Dundy	129	487	3 77	2835	1313	46	2729	1589	58	3783
Fillmore	715	4211	5 89	291	147	50	26826	30149	1 14	15500
Franklin	689	3404	4 94	618	322	52	22451	20519	91	7264
Frontier	562	2682	4 77	372	149	40	19177	13932	72	11460
Furnas	740	4255	5 74	842	421	50	38520	24772	65	15373
Gage	1521	11201	7 36	592	236	57	42974	58865	1 37	28894
Garfield	58	389	6 70	461	218	47	2200	2705	1 26	1806
Gosper	385	2338	6 07	.....	.....	.....	18294	11555	63	7714
Grant	57	308	6 40	.....	.....	.....	46	99	2 15	.....
Greeley	191	1359	7 11	75	38	50	10572	11501	1 08	6205
Hall	777	4890	6 29	15458	11569	74	25502	23694	93	12957
Hamilton	634	3710	5 85	272	177	65	34873	32845	94	12595
Harlan	661	3938	5 96	661	661	1 00	19549	18664	95	8000
Hayes	287	912	3 18	.....	.....	.....	5961	6706	1 12	4064
Hitchcock	360	1710	4 75	.....	.....	.....	5444	5797	1 06	5854

Digitized by Google

Holt	326	$ 2608	$ 8 00	10806	$ 5437	50	13649	$ 6828	$ 50	$ 7982
Hooker							188	193	1 40	208
Howard	628	3825	6 14	493	179	36	21518	19509	91	12378
Jefferson	887	4857	5 80	7158	3003	42	22424	23302	1 04	14084
Johnson	631	4246	6 72	142	71	50	22739	27078	1 19	14247
Kearney	531	3875	6 35	4166	2018	48	24413	25286	1 03	10479
Keith	125	497	3 97	3305	994	30	1090	1097	1 00	1118
Keya Paha	181	1452	8 02	3612	2080	57	1350	1370	1 01	1948
Kimball	33	82	2 46	7434	3686	49	33	20	60	292
Knox	665	4688	7 04	592	295	49	22714	28071	1 23	13997
Lancaster	1070	6187	5 78	15532	5691	36	34680	33326	96	25928
Lincoln	499	2166	4 34	1240	372	30	12815	12838	1 00	9553
Logan	42	242	5 76				1733	1219	70	
Loup	58	509	8 77	14	9	68	2149	5003	2 32	1719
Madison	648	3792	5 89	1608	697	43	29060	29882	1 03	15764
McPherson	9	69	7 66	4	1	25	138	91	61	303
Merrick	231	1496	6 47	7177	3196	44	17019	18106	1 06	6772
Nance	588	3853	6 55	856	214	25	21715	15838	73	6423
Nemaha	1023	9731	9 51	581	288	50	24614	3.058	1 30	18544
Nuckolls	737	5372	7 28	95	23	24	26057	32799	1 25	12517
Otoe	1443	11808	8 18	236	116	50	32434	39568	1 22	24851
Pawnee	460	4255	9 25	643	399	62	28078	36367	1 29	15395
Perkins	85	269	3 16	3005	812	27	1319	459	34	1633
Phelps	650	2676	4 12	42	20	48	18136	14399	79	10747
Pierce	528	2849	5 39	1041	656	63	18113	17480	96	8447
Platte	431	3969	9 20	3543	1898	53	36063	21239	58	12542
Polk	735	6047	8 22	1869	618	33	30048	21388	71	15695
Red Willow	442	1883	4 26	785	213	27	22807	13713	60	7732
Richardson	1287	9844	7 65	1245	561	45	39659	46122	1 16	14148
Rock	106	634	5 98	3921	2821	71	1008	1308	1 29	2534
Saline	625	3259	5 21	154	1905	68	31141	28528	91	24211
Sarpy	687	5759	9 04	118	61	52	13775	18985	1 38	9583
Saunders	1012	8552	8 46	16036	5094	32	48343	56324	1 17	27519
Scott's Bluff	71	618	8 70	9662	8696	90	966	2187	2 21	2445
Seward	726	4942	6 81	187	181	70	28615	27674	96	18533
Sheridan	340	1825	5 36	20701	9728	46	1371	1160	84	7386
Sherman	368	1695	4 60	144	63	44	12175	11678	96	8399
Sioux	113	1045	9 24	12858	9744	75	234	362	1 54	2455
Stanton	496	3223	6 50	539	260	48	18590	17162	92	10109
Thayer	918	5981	6 51	476	2058	54	31622	32754	1 03	17761
Thomas	10	49	4 90	13	3	23	199	116	58	165
Thurston	245	2500	10 21	8	14	1 75	5648	8396	1 48	7920
Valley	440	2143	4 87	609	248	41	15963	13625	85	6138
Washington	570	5501	9 65	1030	882	85	27578	33510	1 21	14107
Wayne	545	5066	9 29	307	127	41	22690	23300	1 03	10498
Webster	712	4664	6 55	601	146	24	31688	20395	64	11253
Wheeler	55	381	6 92	348	390	1 12	2773	5688	2 05	1776
York	782	4810	6 15	754	375	49	35178	37989	1 07	17994
Total	43148	$ 287050	$ 6 65	260823	$ 139868	$ 53	1606668	$ 1609241	$ 1 00	$ 896889

Digitized by Google

STATISTICAL REPORT FOR YEAR 1896.—*Concluded.*

COUNTIES	NUMBER OF ACRES OF												NUMBER OF		
	Wheat.	Corn.	Oats.	Barley.	Meadow.	Flax.	Rye.	Millet.	Alfalfa.	Sug'r Beets	Potatoes.	Miscellaneous	Fruit trees.	Forest trees.	Grape Vines.
Adams	‡														
Antelope	20755	76134	29912	638	4880		3247	462					19222	2479881	460
Banner	‡														
Blaine	‡														
Boone	37127	92231	36840	1470	17848		3457	1241					231731	2328277	1963
Box Butte	5165	5744	1675	291			96	333			622		80	10413	
Boyd	‡														
Brown	‡														
Buffalo	‡														
Burt	18923	104339	25518	2388	45845		974	453				5327	88390	1390757	12787
Butler	17226	137613	60356	1671	21304	292	3416					557	69215	1083294	12478
Cass	17321	100226	16070	286	22446		364				216	4	159898	606650	33131
Cedar	51854	92122	28823	5212	24953	748	759	839				40	16744	2880954	2895
Chase	9870	12300	560	140					560						
Cherry	8914	7745	1714	85	3290		115				42		100	80350	7113
Chevenne	‡														
Clay	43132	152102	37464	2411	27107	407	1004	297	53	10		224	99910	813714	
Colfax	‡														
Cuming	45102	115839	36341	2302	61840	28	642	524		118			60079	2431000	28250
Custer	‡														
Dakota	30000	50000	20000	2000	6000								12000	25000	8000
Dawes	‡														
Dawson	84296	99935	10675	3517	37585		5769		2422			144	12267	390984	1128
Deuel	491	2780	145	113	4485			131	61			22			
Dixon	27261	48573	15216	5376	14853								22030	1185060	2850
Dodge	20387	87144	32496	1894	31052		716	915		286	248	656	64915	845945	15217
Douglas	9766	76488	18188	901	73998		1354	781			746	5108	108103	1926790	156516
Dundy	4204	15774	2697	414	1826		100						2066	299780	
Fillmore	22980	165152	57578	407	29094	1427	1030	70	54			8643	148580	1086759	17019
Franklin	‡														
Frontier	‡														
Furnas	‡														
Gage	28568	207155	42705			2237	2083						232254	710545	30875
Garfield	2167	3714	580	142	28		58	24	7				3290	49850	132
Gosper	17065	47151	4887	447	880		530						8185	329272	863
Grant					10000									200	
Greeley	13027	41020	13123	237	1125								14001	25117	190
Hall	11128	88276	46385	1655	28248		2778			1460	1331		47254	2279725	6765
Hamilton	11681	154245	54292	2456	42272	453	1925	750					88767	124500	8582
Harlan	35088	116304	14640		8872								22865	527782	2100
Hayes	‡														
Hitchcock	‡														

Digitized by Google

Holt	‡															
Hooker	‡															
Howard	31139	58191	16661	970	22700								25191	707650	149
Jefferson	18084	163059	23131	318	27588								155085	513057	17544
Johnson	29091	97486	21825	216	58244	1633	614	568				55	175324	426885	37305
Kearney	28684	85455	9800	651	6858		191		33				24585	438640	1028
Keith	‡															
Keya Paha	‡															
Kimball	‡															
Knox	46051	79687	30716	2641	18296	160	1466	579					12939	1634825	1850
Lancaster	2700	1 4320	45200	240	50060	250	250	1800	275	150	1000		191460	2650000	45100
Lincoln	29830	59811	6457	4563	13543		3830		3415		1123		21862	1252126	1796
Logan	4953	9898		877											
Loup	‡															
Madison	27210	99326	48062	1708	6901		2065	857		921			32430	3121654	2069
McPherson	‡															
Merrick	‡															
Nance	4703	49529	14751	313	736	281	1859	529					13349	126507	2702
Nemaha	23588	93933	17404	388	36180								226229	698730	59638
Nuckolls	27267	146902	17786	655	17997		1577	1050	286				130160	315262	8713
Otoe	33897	177017	45872	225	23366		201					9133	184585	913300	79463
Pawnee	12000	95000	20000		16000								175000		8000
Perkins	10117	6871	320	68	30		674						450	40000	60
Phelps	‡															
Pierce	36076	57945	17444	1141												
Platte	‡															
Polk	8300	120480	48960	950	32000	460	9400	3000	1650		962	42000	73670	1145340	7200
Red Willow	‡															
Richardson	‡															
Rock	1577	5692	788	45	1048								1864	780000	71
Saline	65810	105145	34158	1055	35429		892	345					168940	429206	45296
Sarpy	‡															
Saunders	‡															
Scott's Bluff	‡															
Seward	17515	78210	47080	1400	17687								90168	106394	26976
Sheridan	‡															
Sherman	32000	42000	10000	300	300								12000	50000	1000
Sioux	‡															
Stanton	29761	72231	21749	944	31248	242	1514	364		51			16496	640382	5130
Thayer	27851	162784	24161	606	29988	224	672	282	98	55		150	114799	370882	16307
Thomas	‡															
Thurston	‡															
Valley	37719	49332	11493	607	825	180	1934	322				20	25191	879666	2364
Washington	17048	67661	21932	1328	16509		553						62655	275167	30170
Wayne	44175	83223	18765	632	16763	1115	409	814	30	5		12	39453	1449385	8283
Webster	12240	127022	13276	380	13795		754	200	14		70	109	61324	244617	9505
Wheeler	50	2579	882	56	3710		99						4192	134000	
York	17548	73148	28103	2248	16450	123	1825				192		37091	96271	2665
Total	1270477	4503038	1225613	61978	1019032	10260	61191	17530	8958	3056	6552	72204	3608383	43248581	768192

‡ Not reported.

Digitized by Google

The foregoing table is taken, principally, from the official records of State Auditor's officer, and as furnished by county officials.

Strange as it may seem, two serious confrontings prevent efforts to obtain agricultural statistics. The erroneous impressions that they are for the benefit of "middle men," or to "increase taxable valuations."

COUNTY REPORTS IN DETAIL.

A few counties through county agricultural societies, send direct to the Secretary of the State Board more complete and detailed renditions, such as the following:

NOTE.—All yields here given are averages for the county named.

BURT COUNTY.—*Winter wheat*, 15 bushels per acre, 70 cents per bushel. *Spring wheat*, 15 bushels per acre, 70 cents per bushel. *Rye*, 20 bushels per acre, 25 cents per bushel. *Corn*, 25 bushels per acre, 15 cents per bushel. *Barley*, 25 bushels per acre, 35 cents per bushel. *Oats*, 35 bushels, 15 cents per bushel. *Buckwheat*, 25 bushels per acre. *Flax*, 8 bushels per acre, 60 cents per bushel. *Potatoes*, 50 bushels per acre, 50 cents per bushel. Osage hedge, 70 miles. Apple trees, 150,000. Cherry trees, 12,000. Grape vines, 100,000. One railroad. Tillable acres land, 375,000; under cultivation, 300,000 acres.

BROWN COUNTY.—*Winter wheat*, none. *Spring wheat*, average yield per acre, 8 bushels; average price per bushel, 65 cents. *Rye*, average yield per acre, 20 bushels; average price per bushel, 60 cents. *Corn*, average yield per acre, 25 bushels; average price per bushel, 14 cents. *Oats*, average yield per acre, 30 bushels; average price per bushel, 12 cents. *Potatoes*, average yield per acre, 150 bushels; average price per bushel, 25 cents. *Onions*, average yield per acre, 300 bushels; average price per bushel, 75 cents. *Sorghum*, average yield per acre, 50 gallons; average price per gallon, 40 cents. *Millet*, yield per acre, 2 tons, price $2.50 per ton. Forest trees planted and growing in county, 7,000,000. Apple trees in county, 20,000. Five flouring mills, 2 saw mills, and 2 irrigation plants in the county. Soil, rich, sandy loam. Acres of land tillable, 200,000; under cultivation, 180,000. F., E. & M. V. railroad traverses the county. Splendid water power. Crops, wheat, corn, oats, rye, barley, buckwheat, beans, potatoes.

CEDAR COUNTY.—*Winter wheat*, yield per acre 20 bushels, price per bushel 80 cents. *Spring wheat*, yield per acre 10 bushels, price per bushel 75 cents. *Rye*, yield per acre 18 bushels, price per bushel 18 cents. *Corn*, yield per acre 30 bushels, price per bushel 15 cents. *Barley*, yield per acre 25 bushels, price per bushel 30 cents. *Oats*, yield per acre 30 bushels, price per bushel 15 cents. *Potatoes*, yield per acre 200 bushels, price per bushel 50 cents. Six flouring mills, 3 saw mills, 1 brewery, 3 railroads, 480,000 acres tillable land, of which 270,000 are under cultivation.

CUMING COUNTY.—*Winter wheat*, none. *Spring wheat*, yield per acre 15 bushels, price per bushel 70 cents. *Rye*, yield per acre 25 bushels, price per bushel 32 cents. *Corn*, yield per acre 40 bushels, price per bushel 16 cents. *Barley*, yield per acre 15 bushels, price per bushel 35 cents. *Oats*,

Digitized by Google

yield per acre 50 bushels, price per bushel 15 cents. *Potatoes*, yield per acre 100 bushels, price per bushel 50 cents. Forest trees, planted and growing 2,431,000, grape vines 28,250, 4 flouring mills, 1 brewery, 3 creameries, 1 planing mill, 4 brick yards, 1 canning factory, 1 railroad, black rich soil, tillable acres land 362,000.

CLAY COUNTY.—*Winter wheat*, yield per acre 15 bushels, price per bushel 70 cents. *Spring wheat*, yield per acre 10 bushels, price per bushel 70 cents. *Rye*, yield per acre 12 bushels, price per bushel 30 cents. *Corn*, yield per acre 30 bushels, price per bushel 15 cents. *Barley*, yield per acre 10 bushels, price per bushel 30 cents. *Oats*, yield per acre 25 bushels, price per bushel 16 cents. *Potatoes*, yield per acre 30 bushels, price per bushel 50 cents. *Millet*, yield per acre 2 tons, price per ton $4. *Timothy*, yield per acre 2 tons, price per ton $3. *Clover*, yield per acre 2 tons, price per ton $5. *Alfalfa*, yield per acre 3 tons, price per ton $5. Forest trees, planted and growing, 2,542,211; rods hedge fence growing in county 10,000; apple trees, 100,000; plum, 20,000; cherry, 4,500; tillable acres of land in county, 368,640, of which 348,640 are under cultivation.

DAWSON COUNTY.—*Winter wheat*, as high as 50 bushels per acre, 80 cents per bushel. *Spring wheat*, 15 bushels per acre, 75 cents per bushel. *Rye*, 12 bushels per acre, 30 cents per bushel. *Corn*, 35 bushels per acre, 16 cents per bushel. *Barley*, 20 bushels per acre, 16 cents per bushel. *Oats*, 40 bushels per acre, 14 cents per bushel. *Buckwheat*, 16 bushels per acre, 70 cents per bushel. *Flax*, 4 bushels per acre, 90 cents per bushel. *Potatoes*, 250 bushels per acre, 5 cents per bushel. *Onions*, 600 bushels per acre, 75 cents per bushel. *Millet*, 5 tons per acre, $6 per ton. *Clover*, 2½ tons per acre, $5 per ton. *Alfalfa*, 5 tons per acre, $4 per ton. Cultivated timber, 700,000 trees. Apple trees, 12,000; pear trees, 1,000; peach trees, 2,000; plum trees, 6,000; cherry trees, 4,000; grape vines, 5,000. Three lines of railroad. Tillable acres of land, 450,000; under cultivation, 250,000 acres.

DAWES COUNTY.—*Winter wheat*, yield per acre 12 bushels, price per bushel 55 cents. *Spring wheat*, yield per acre 10 bushels, price per bushel 48 cents. *Rye*, yield per acre 10 bushels, price per bushel 22 cents. *Corn*, yield per acre 15 bushels, price per bushel 25 cents. *Barley*, yield per acre 12 bushels, price per bushel 30 cents. *Oats*, yield per acre 20 bushels, price per bushel 17 cents. *Buckwheat*, yield per acre 15 bushels, price per bushel 70 cents. *Flax*, yield per acre 7 bushels, price per bushel 90 cents. *Beans*, yield per acre 8 bushels, price per bushel $2. *Potatoes*, yield per acre 65 bushels, price per bushel 30 cents. *Sweet Potatoes*, yield per acre 45 bushels, price per bushel $2. *Onions*, yield per acre 100 bushels, price per bushel 70 cents. *Sorghum*, yield per acre 100 gallons, price per gallon 50 cents. *Broom Corn*, yield per acre 1½ tons, price per ton $45. *Millet*, yield per acre 1½ tons, price per ton $4. *Hungarian*, yield per acre 1½ tons, price per ton $4. *Blue Grass*, yield per acre 1 ton, price per ton $4.50. *Timothy*, yield per acre 1¼ tons, price per ton $4. *Alfalfa*, yield per acre 2½ tons, price per ton $4. Forest trees planted and growing 8,476,840. Apple trees, 6,000. Plum trees, 8,000. Grape vines, 1,000. Manufactories,

Digitized by Google

6 flour mills, 8 saw mills, 2 broom factories, 2 cigar manufactories, good water power, 1 railroad, 5-6 of the land in county tillable, of which 150,000 acres are under cultivation. Crops all as above named.

DOUGLAS COUNTY.—*Winter wheat*, yield per acre 17 bushels, price per bushel 76 cents. *Spring wheat*, yield per acre 18 bushels, price per bushel 76 cents. *Rye*, yield per acre 25 bushels, price per bushel 40 cents. *Corn*, yield per acre 40 bushels, price per bushel 20 cents. *Barley*, yield per acre 30 bushels, price per bushel 30 cents. *Oats*, yield per acre 40 bushels, price per bushel 18 cents. *Buckwheat*, yield per acre 10 bushels, price per bushel 70 cents. *Beans*, yield per acre 15 bushels, price per bushel $1.25. *Potatoes*, yield per acre 100 bushels, price per bushel 40 cents. *Sweet potatoes*, yield per acre 150 bushels, price per bushel 60 cents. *Onions*, yield per acre 350 bushels, price per bushel 50 cents. *Broom corn*, yield per acre ½ ton, price per ton $45. *Millet*, yield per acre 3 tons, price per ton $4. *Blue grass*, yield per acre 1 ton, price per ton $6. *Timothy*, yield per acre 1½ tons, price per ton $5. *Clover*, yield per acre 2 tons, price per ton $6. *Alfalfa*, yield per acre 5 tons, price per ton $6. Apple trees in county 150,000, pear 2,500, peach 2,000, plum 15,000, cherry 20,000, grape vines, 175,220. Fourteen lines railroad. Tillable land 200,000 acres, under cultivation 189,600. Crops, all known to the West.

FILLMORE COUNTY.—*Winter wheat*, yield per acre 16 bushels, price per bushel 68 cents. *Spring wheat*, yield per acre 12 bushels, price per bushel 68 cents. *Rye*, yield per acre 16 bushels, price per bushel 30 cents. *Corn*, yield per acre 30 bushels, price per bushel 15 cents. *Barley*, yield per acre 25 bushels, price per bushel 20 cents. *Oats*, yield per acre 40 bushels, price per bushel 15 cents. *Flax*, yield per acre 10 bushels. *Potatoes*, yield per acre 100 bushels, price per bushel 48 cents. Forest trees planted and growing, 1,026,789; apple trees in orchard, 148,580, cherry trees, 7,840, peach trees, 1820, grape vines, 17,019, 4 flouring mills, 3 lines railroad, tillable acres land in county 355,824.

GREELEY COUNTY.—*Winter wheat*, yield per acre 10 bushels, price per bushel 75 cents. *Spring wheat*, yield per acre 14 bushels, price per bushel 65 cents. *Rye*, yield per acre 20 bushels, price per bushel 31 cents. *Corn*, yield per acre 30 bushels, price per bushel 14 cents. *Barley*, yield per acre 28 bushels, price per bushel 35 cents. *Oats*, yield per acre 25 bushels, price per bushel 14 cents. *Potatoes*, yield per acre 80 bushels, price per bushel 30 cents. *Millet*, yield per acre 2 tons, price per ton $3.50. *Timothy*, yield per acre 5 tons, price per ton $3. *Alfalfa*, yield per acre 2½ tons, price per ton $4. Forest trees, planted and growing in county, 6,540,000. Rods hedge fence in county, 78,000; apple trees, 70,000; apples raised, 5,000 bushels; 4 flouring mills, 4 broom factories, and 2 creameries in the county; water power abundant, 2 lines of railroad. Soil, sandy loam; tillable acres of land 200,000, under cultivation 170,000 acres.

HOLT COUNTY.—*Winter Wheat*, average yield per acre 15 bushels, average price per bushel 60 cents. *Spring Wheat*, average yield per acre 8 bushels, average price 55 cents. *Rye*, average yield per acre 10 bushels, average price per bushel 22 cents. *Corn*, average yield per acre 15 bush-

Digitized by Google

els, average price per bushel 15 cents. *Barley*, average yield per acre 25 bushels, average price per bushel 30 cents. *Oats*, average yield per acre 25 bushels, average price per bushel 12 cents. *Buckwheat*, average yield per acre 10 bushels, average price per bushel 25 cents. *Flax*, average yield per acre 4 bushels, average price per bushel $1. *Beans*, average yield per acre 6 bushels, average price per bushel $1.50. *Potatoes*, average yield per acre 50 bushels, average price per bushel 20 cents. *Onions*, average yield per acre 100 bushels, average price per bushel 60 cents. *Millet*, average yield per acre 1½ tons, average price per ton $4. *Alfalfa*, average yield per acre 2 tons, average price $4 per ton. *Sorghum*, average yield per acre 150 gallons, average price 25 cents per gallon. *Broom Corn*, average yield per acre ½ ton. Fruit trees and vines in the county, apples 10,000, pears 500, peaches 500, plums 2,000, cherries 2,000, grape vines 1,000. Manufactories, 6 flouring mills, 1 brewery, 1 chicory factory, 6 creameries. Tillable acres of land in the county, 300,000, under cultivation 150,000, soil sandy loam, good water power, two lines of railroad in county. Principal crops, corn, wheat, oats, rye, barley, flax, millet, chicory, potatoes.

HALL COUNTY.—*Winter wheat*, yield per acre 18 bushels, price per bushel 65 cents. *Spring wheat*, yield per acre 16 bushels, price per bushel 60 cents. *Rye*, yield per acre 25 bushels, price per bushel 35 cents. *Corn*, yield per acre 40 bushels, price per bushel 15 cents. *Barley*, yield per acre 28 bushels, price per bushel 27 cents. *Oats*, yield per acre 20 bushels, price per bushel 15 cents. *Buckwheat*, yield per acre 35 bushels, price per bushel 45 cents. *Flax*, yield per acre 8 bushels, price per bushel $1. *Beans*, yield per acre 12 bushels, price per bushel $1. *Potatoes*, yield per acre 125 bushels, price per bushel 25 cents. *Sweet Potatoes*, yield per acre 50 bushels, price per bushel 50 cents. *Onions*, yield per acre 200 bushels, price per bushel 50 cents. *Sorghum*, yield per acre 40 gallons, price per gallon $1. *Broom Corn*, yield per acre ½ ton, price per ton $40. *Millet*, yield per acre 2 tons, price per ton $3. *Blue Grass*, yield per acre 3 tons, price per ton $5. *Timothy*, yield per acre 2 tons, price per ton $5. *Clover*, yield per acre 2 tons, price per ton $5. *Alfalfa*, yield per acre 5 tons, price per ton $5. Forest trees planted and growing in county, 3,000,000. Rods of hedge fence, 10,000. Apple trees, 65,000, bushels of apples 4,000. Peaches, 2,500 trees. Cherry trees, 1,500. Grape vines, 12,000. Manufactories, 5 flouring mills, 1 foundry, 3 brick yards, 1 canning factory, 1 broom factory, 7 cigar factories, 1 creamery with an output of 40,000 pounds, 1 sugar beet factory with an output of 7,000,000 pounds granulated sugar in 1897, 5 railroads. Soil sandy loam, tillable acres of land 320,396, under cultivation 250,000 acres. Crops, a full line of all raised in the West; sugar beets a large factor.

HAMILTON COUNTY.—*Winter wheat*, yield per acre 30 bushels, price per bushel 72 cents. *Spring wheat*, yield per acre 15 bushels, price per bushel 65 cents. *Rye*, yield per acre 20 bushels, price per bushel 35 cents. *Corn*, yield per acre 45 bushels, price per bushel 13 cents. *Barley*, yield per acre 30 bushels, price per bushel 50 cents. *Oats*, yield per acre 35 bushels, price per bushel 13 cents. *Flax*, yield per acre 12 bushels, price per

Digitized by Google

bushel 80 cents. *Potatoes*, yield per acre 75 bushels, price per bushel 50 cents. *Alfalfa*, yield yer acre 4 tons, price per ton $3. Apple trees in county 120,000. Grape vines, 25,000. Two flouring mills and three creameries in the county. Two lines of railroad. Acres tillable land 329,026, under cultivation 281,319. Crops, all known to the western country. Soil, black loam.

JEFFERSON COUNTY.—*Winter wheat*, yield per acre 20 bushels, price per bushel 65 cents. *Rye*, yield per acre 20 bushels, price per bushel 35 cents. *Corn*, yield per acre 35 bushels, price per bushel 16 cents. *Oats*, yield per acre 35 bushels, price per bushel 14 cents. *Potatoes*, yield per acre 80 bushels, price per bushel 45 cents. Fruit trees, all kinds, 155,035. Grape vines, 17,554. Forest trees, planted and growing 513,157. Four flouring mills. Water power in abundance. Five lines of railroad. Tillable acres of land 350,059, under cultivation 224,507. Crops, all known in the West.

KEARNEY COUNTY.—*Winter wheat*, 22 bushels per acre, 72 cents per bushel. *Spring wheat*, 14 bushels per acre, 70 cents per bushel. *Rye*, 14 bushels per acre, 23 cents per bushel. *Corn*, 31 bushels per acre, 15 cents per bushel. *Barley*, 35 bushels per acre, 22 cents per bushel. *Oats*, 45 bushels per acre, 13 cents per bushel. *Flax*, 10 bushels per acre, 70 cents per bushel. *Potatoes*, 100 bushels per acre, 30 cents per bushel. *Onions*, 150 bushels per acre, 50 cents per bushel. *Sorghum*, 100 gallons per acre, 25 cents per gallon. *Millet*, 2 tons per acre, $3 per ton. *Alfalfa*, 3 tons per acre, $3 per ton. Cultivated timber, 813,901 trees; rods hedge fence, 15,460; apple trees, 75,000; bushels apples raised, 2,500; peach trees, 4,000; plum trees, 7,500; cherry trees, 15,000; grape vines, 3,500; 2 lines railroad, tillable acres of land, 304,486; under cultivation, 232,140 acres.

LANCASTER COUNTY.—*Winter Wheat*, 18 bushels per acre, 65 cents per bushel. *Spring Wheat*, 16 bushels per acre, 65 cents per bushel. *Rye*, 25 bushels per acre, 30 cents per bushel. *Corn*, 30 bushels per acre, 18 cents per bushel. *Barley*, 20 bushels per acre, 40 cents per bushel. *Oats*, 30 bushels per acre, 16 cents per bushel. *Buckwheat*, 20 bushels per acre, 70 cents per bushel. *Potatoes*, 65 bushels per acre, 50 cents per bushel. *Onions*, 100 bushels per acre, $1 per bushel. *Millet*, 2½ tons per acre, $4 per ton. *Hungarian*, 3 tons per acre, $4 per ton. *Timothy*, 1½ tons per acre, $6 per ton. *Clover*, 3 tons per acre, $6 per ton. *Alfalfa*, 3 tons per acre, $5 per ton. Apple trees, 100,000; pear trees, 5,000; peach trees, 50,000; plum trees, 10,000; cherry trees, 25,000; grape vines, 45,000. Eight lines railroad. Tillable land 485,000 acres, under cultivation 365,071.

NEMAHA COUNTY.—*Winter wheat*, yield per acre 22 bushels, price per bushel 70 cents. *Spring wheat*, yield per acre 18 bushels, price per bushel 65 cents. *Rye*, yield per acre 25 bushels, price per bushel 30 cents. *Corn*, yield per acre 35 bushels, price per bushel 18 cents. *Barley*, yield per acre 35 bushels, price per bushel 25 cents. *Oats*, yield per acre 42 bushels, price per bushel 18 cents. *Buckwheat*, yield per acre 22 bushels, price per bushel $1. *Potatoes*, yield per acre 75 bushels, price per bushel 50 cents. *Millet*, yield per acre 2½ tons, price per ton $3. *Timothy*, yield per acre 2½ tons, price per ton $4.75. *Clover*, yield per acre 3 tons, price per ton

Digitized by Google

$3.50. *Alfalfa*, yield per acre 4 tons, price per ton $5 *Sugar beets*, yield per acre 20 tons, price per ton $4.50. Forest trees planted and growing in county 8,256,945. Rods osage fence in county 284,906. Apple trees in county 1,222,140. Apples raised 225,480 bushels, price per bushel 35 cents. Peach trees, 84,240. Peaches raised 34,640 bushels. Plum trees, 40,250. Plums raised 80,120 cases. Cherry trees 18,400. Cherries raised 26,260 cases. Grape vines, 280 960. Grapes raised, 125,102 baskets. Acres tillable land in county 275,980, under cultivation 190,654. Two lines railroad. Water power abundant. Soil, rich loam. Eight flouring mills in county. Crops, all known and successful in the new West.

NUCKOLLS COUNTY.—*Winter wheat*, average yield per acre 20 bushels, average price per bushel 70 cents. *Spring wheat*, average yield per acre 15 bushels, average price per bushel 65 cents. *Rye*, average yield per acre 15 bushels. *Corn*, average yield per acre 35 bushels, average price per bushel 16 cents. *Oats*, average yield per acre 40 bushels, average price per bushel 15 cents. *Alfalfa*, average yield per acre 2 tons, average price per ton $5. Forest trees planted in the county and now growing, 315,262. Apple trees in the county in orchards, 130,161. Acres of land under cultivation, 256,275. Excellent water power, three roller mills. Five railroads in the county. Principal crops: corn, wheat, barley, rye, flax, tame grasses, potatoes.

PLATTE COUNTY.—*Winter wheat*, yield per acre 25 bushels, price per bushel 72 cents. *Spring wheat*, yield per acre 15 bushels, price per bushel 72 cents. *Rye*, yield per acre 30 bushels, price per bushel 25 cents. *Corn*, yield per acre 45 bushels, price per bushel 16 cents. *Barley*, yield per acre 40 bushels, price per bushel 25 cents. *Oats*, yield per acre 30 bushels, price per bushel 16 cents. *Buckwheat*, yield per acre 20 bushels, price per bushel 35 cents. *Flax*, yield per acre 12 bushels, price per bushel 75 cents. *Potatoes*, yield per acre 100 bushels, price per bushel 50 cents. *Onions*, yield per acre 500 bushels, price per bushel 50 cents. *Sorghum*, yield per acre 50 gallons, price per gallon 40 cents. *Broom corn*, 1¼ tons per acre, price $50 per ton. *Millet*, 2½ tons per acre, price per ton $3. *Timothy*, 1½ tons per acre, $4 per ton. *Alfalfa*, 5 tons per acre, $5 per ton. Cultivated timber, 7,000,000 trees, apple trees, 55,000; peach trees, 7,000; plum trees, 4,000; cherry trees, 18,000, grape vines, 6,000; 2 lines railroad—on main line U. P. Tillable acres of land 390,000, under cultivation 210,000 acres.

POLK COUNTY.—*Winter wheat*, yield per acre 25 bushels, price per bushel 60 cents. *Spring Wheat*, yield per acre 15 bushels, price per bushel 60 cents. *Rye*, yield per acre 15 bushels, price per bushel 60 cents. *Corn*, yield per acre 25 bushels, price per bushel 15 cents. *Barley*, yield per acre 18 bushels, price per bushel 20 cents. *Oats*, yield per acre 25 bushels, price per bushel 15 cents. *Buckwheat*, yield per acre 10 bushels, price per bushel 60 cents. *Flax*, yield per acre 12 bushels, price per bushel 75 cents. *Potatoes*, yield per acre 50 bushels, price per bushel 40 cents. *Onions*, yield per acre 50 bushels, price per bushel 30 cents. *Broomcorn*, yield per acre ¼ ton, price per ton $45. *Millet*, yield per acre 1½ tons, price per ton $3. *Timothy*, yield per acre 2 tons, price per ton $4. *Clover*, yield per

Digitized by Google

acre 1½ tons, price per ton $3. *Alfalfa*, yield per acre 1½ tons, price per ton $3. Cultivated timber, 1,045,340 trees. Rods osage hedge fence 3,500. Apple trees 10,800. Grape vines 15,600. Tillable acres land 230,000. Under cultivation 200,000. Two lines railroad.

PAWNEE COUNTY.—*Winter wheat*, yield per acre 20 bushels, price per bushel 75 cents. *Rye*, yield per acre 15 bushels, price per bushel 40 cents. *Corn*, yield per acre 35 bushels, price per bushel 18 cents. *Oats*, yield per acre 25 bushels, price per bushel 15 cents. *Potatoes*, yield per acre 55 bushels, price per bushel 60 cents. *Sorghum*, yield per acre 50 gallons, price per gallon 40 cents. *Millet*, yield per acre 2 tons, price per ton $3. *Timothy*, yield per acre 1½ tons, price per ton $5. *Clover*, yield per acre 2 tons, price per ton $5. *Alfalfa*, yield per acre 3 tons, price per ton $5. Rods of osage hedge 250,000. Apple trees 150,000. Bushels apples raised 15,000. Pear trees 2,500. Peach trees 5,500. Plum trees 3,400. Cherry trees 5,800. Grape vines 35,500. Three lines railroad. Tillable acres land 260,000. Under cultivation 150,000 acres.

PIERCE COUNTY.—*Spring wheat*, yield per acre 8 bushels, price per bushel 70 cents. *Rye*, yield per acre 20 bushels, price per bushel 30 cents. *Corn*, yield per acre 30 bushels, price per bushel 15 cents. *Oats*, yield per acre 30 bushels, price per bushel 15 cents. Two lines of railroad.

WASHINGTON COUNTY.—*Winter wheat*, none. *Spring wheat*, yield per acre 18 bushels, price per bushel 75 cents. *Rye*, yield per acre 15 bushels, price per bushel 33 cents. *Corn*, yield per acre 37 bushels, price per bushel 16 cents. *Barley*, yield per acre 20 bushels, price per bushel 35 cents. *Oats*, yield per acre 35 bushels, price per bushel 15 cents. *Potatoes*, yield per acre 70 bushels, price per bushel 50 cents. *Millet*, yield per acre 1 ton, price per ton $3.50. *Alfalfa*, yield per acre 6 tons, price per ton $4. Planted timber, growing in the county 1,456,874 trees. Apple trees growing in the county 132,896. Bushels apples raised in county 1897, 52,860, price per bushel 50 cents. Three flouring mills, 4 railroads. Land, bottom and upland. Crops, all that are grown in the West. Tillable acres land 191,256, under cultivation 172,860.

RED WILLOW COUNTY.—*Winter wheat*, yield per acre 15 bushels, price per bushel 60 cents. *Spring wheat*, yield per acre 15 bushels, price per bushel 60 cents. *Rye*, yield per acre 12 bushels, price per bushel 30 cents. *Corn*, yield per acre 25 bushels, price per bushel 15 cents. *Oats*, yield per acre 15 bushels, price per bushel 25 cents. *Potatoes*, yield per acre 50 bushels, price per bushel 50 cents. *Alfalfa*, yield per acre 4½ tons, price per ton $3. Main line B. & M. R. R. Crops, corn, wheat, rye, potatoes, alfalfa, sugar beets. Three-fourths total average of county tillable, one-fifth total average of county under cultivation.

RICHARDSON COUNTY.—*Winter wheat*, yield per acre 20 bushels, price per bushel 70 cents. *Spring wheat*, yield per acre 15 bushels, price per bushel 65 cents. *Rye*, yield per acre 20 bushels, price per bushel 30 cents. *Corn*, yield per acre 35 bushels, price per bushel 18 cents. *Barley*, yield per acre 35 bushels, price per bushel 25 cents. *Oats*, yield per acre 40 bushels, price per bushel 15 cents. *Buckwheat*, yield per acre 20 bushels, price per

Digitized by Google

bushel $1. *Beans*, yield per acre 20 bushels, price per bushel $1.50. *Potatoes*, yield per acre 50 bushels, price per bushel 60 cents. *Sweet Potatoes*, yield per acre 100 bushels, price per bushel 75 cents. *Onions*, yield per acre 50 bushels, price per bushel 50 cents. *Sorghum*, yield per acre 20 gallons, price per gallon 35 cents. *Millet*, yield per acre 2 tons, price per ton $2. *Timothy*, yield pe acre 2 tons, price per ton $5. *Clover*, yield per acre 2 tons, price per ton $3. *Alfalfa*, yield per acre 3 tons, price per ton $2. Forest trees, planted and growing in county 3,144,356. Apple trees, in county 259,000, bushels apples raised 2,112,211, price per bushel 30 cents. Pear trees, 100,000, peach trees, 50,000, plum trees, 20,000, cherry trees, 10,000, grape vines, 20,000. Rods osage hedge fence in county 108,000, 7 flouring mills in county, 2 lines of railroad, 300,000 acres tillable land in county, 250,000 under cultivation. Crops, corn, oats, wheat, barley, rye, tame grasses, flax, potatoes, alfalfa.

SEWARD COUNTY.—*Winter wheat*, yield per acre 25 bushels, price per bushel 68 cents. *Spring wheat*, yield per acre 14 bushels, price per bushel 65 cents. *Rye*, yield per acre 20 bushels, price per bushel 32 cents. *Corn*, yield per acre 30 bushels, price per bushel 16 cents. *Barley*, yield per acre 27 bushels, price per bushel 24 cents. *Oats*, yield per acre 45 bushels, price per bushel 17 cents. Forest trees planted and growing in county 106,394, fruit trees, 90,168, grape vines, 26,976. Tillable acres of land 331,776, under cultivation 221,184 acres. Eight flouring mills in county. Water power abundant.

SHERMAN COUNTY.—*Winter wheat*, yield per acre 16 bushels, price per bushel 66 cents. *Spring wheat*, yield per acre 15 bushels, price per bushel 66 cents. *Rye*, yield per acre 18 bushels, price per bushel 30 cents. *Corn*, yield per acre 25 bushels, price per bushel 15 cents. *Oats*, yield per acre 30 bushels, price per bushel 15 cents. *Potatoes*, yield per acre 50 bushels, price per bushel 37 cents. *Millet*, yield per acre 3 tons. Apple trees in county, 12,500. Grape vines, 2,300. Two flouring mills, 2 railroads. Rainfall, 1897, 34.62 inches. Crops, corn, wheat, oats, barley, rye, potatoes, sugar beets, broom corn, sorghum, alfalfa. Tillable acres land 300,000, under cultivation 125,000.

YORK COUNTY.—*Winter wheat*, yield per acre 30 bushels, price per bushel 50 cents. *Spring wheat*, yield per acre 12 bushels, price per bushel 50 cents. *Rye*, yield per acre 15 bushels, price per bushel 25 cents. *Corn*, yield per acre 40 bushels, price per bushel 12 cents. *Barley*, yield per acre 10 bushels, price per bushel 30 cents. *Oats*, yield per acre 30 bushels, price per bushel 12 cents. *Flax*, yield per acre 6 bushels. Six flouring mills, four creameries, three lines of railroad, 368,000 acres tillable land, 296,637 acres under cultivation. Crops, corn, wheat, rye, barley, oats, sugar beets, timothy, clover, millet, alfalfa.

Digitized by Google

AVERAGE PRICE PER BUSHEL.

December 31, 1897, the average price per bushel for the state for the following leading crops were:

Corn, 17 cents.
Wheat, 69 cents.
Rye, 28 cents.
Oats, 15 cents.
Barley, 24 cents.
Potatoes, 30 cents.
Hay, $3.10 per ton.

AVERAGE YIELDS PER ACRE.

The average yields per acre of the leading crops below named, for the whole state of Nebraska, for the year 1897, were:

Wheat, 12⅛ bushels.
Corn, 29.9 bushels.
Rye, 17 bushels.
Oats, 30⅛ bushels.
Barley, 22 bushels.
Potatoes, 67.10 bushels.
Hay, 1.7 tons per acre.

VALUABLE STATISTICS.

Believing the following condensed tabulations will add to the value of this volume, they are used. To the statistician for the United States Department of Agriculture, the "State Journal Encyclopedia" for 1898, and the "World-Herald Year Book" for 1898, the editor is indebted for the originals.

THE BEET SUGAR INDUSTRY.

GROWTH SINCE 1830.

The manufacture of beet sugar in the United States was of slow and uncertain growth for more than fifty years, but since 1888 it has rapidly increased and is reaching vast proportions. From 1830 to 1863 the entire product amounted to a few thousand pounds. From that time till 1888 there was a variable increase, as shown by the following table:

PRODUCTION OF BEET SUGAR BY YEARS, 1863 TO 1897.

1863–1871.	300 to 500 tons per annum	1886	800 tons
1872	500 tons	1887	255 tons
1873	700 tons	1888	1,010 tons
1874–1877.	less than 100 per annum	1889	2,600 tons
1878	200 tons	1890	2,800 tons
1879	1,200 tons	1891	5 359 tons
1880	500 tons	1892	12,091 tons
1881–1882	less than 500 tons	1893	20,453 tons
1883	535 tons	1894	20,443 tons
1884	953 tons	1895	30,000 tons
1885	600 tons	1896	40,000 tons

BEET SUGAR FACTORIES IN THE UNITED STATES, 1897.

The Western Beet Sugar Company, Watsonville, California; the Chino Beet Sugar Factory, Chino Valley, California; the Alameda Sugar Company, Alvarado, California; the Norfolk Beet Sugar Company, Norfolk, Nebraska; the Oxnard Beet Sugar Company, Grand Island, Nebraska; the

Digitized by Google

Eddy Beet Sugar Factory, Eddy, New Mexico; the Utah Sugar Company, Lehi, Utah. New factories in process of construction in the spring of 1897, or proposed, at Rome, New York; at Menominee Falls, Wisconsin; by Wisconsin Beet Sugar Company, at Milwaukee, Wisconsin; by the Alamitos Sugar Company, at Alamitos, California, and one proposed by Claus Spreckels, at Salinas City, California.

THE WORLD'S SUGAR CROP, 1893 TO 1897.

	1896-97.	1895-96.	1894-95.	1893-94.
	Tons.	*Tons.*	*Tons.*	*Tons.*
United States (beets, 40,000, 1896-97; 30,000, 1895-96; 20,443, 1894-95; 20,453, 1893-94)	315000	267720	337749	286289
Canada (beets)	300	500	300	300
Spanish West Indies:				
Cuba, crop	100000	240000	1040000	1087000
Puerto Rico	58000	50000	52500	60000
British West Indies:				
Trinidad, exports	55000	55000	56641	49662
Barbados, exports	52000	44800	32343	53092
Jamaica	30000	30000	30000	30000
Antigua and St. Kitts	25000	24000	20000	25000
French West Indies:				
Martinique, exports	35000	35000	29000	35854
Guadeloupe	45000	45000	43000	44000
Danish West Indies—St. Croix	8000	8000	7000	8000
Haiti and Santo Domingo	50000	50000	39000	40000
Lesser Antilles, not named above	8000	8000	8000	8000
Mexico	2000	2000	2000	2000
Central America:				
Salvador, crop	500	500	500	500
Nicaragua, crop	500	500	500	500
British Honduras (Belize), crop	200	200	200	200
South America:				
British Guiana (Demerara), exports	115000	105000	95919	102897
Dutch Guiana (Surinam), crop	6000	6000	6000	6000
French Guiana	.....	.....	.....	.....
Venezuela	.....	.....	.....	.....
Peru, crop	70000	68000	68000	65000
Argentina, crop	120000	107000	79000	50000
Brazil, exports	210000	225000	275000	275000
Total in America	1305500	1372220	2221652	2234294
Asia:				
British India, exports	50000	50000	50000	50000
Siam, crop	7000	7000	7000	7000
Java, exports	495000	603259	486051	496383
Japan (consumption 125,000 tons, mostly imported)	.....	.....	.....	.....
Philippine Islands	210000	445000	230000	195000
Cochin China	30000	30000	30000	30000
Total in Asia	792000	935259	803051	778383
Australia and Polynesia:				
Queensland	75000	75000	91712	76146
New South Wales	35000	35000	35000	35000
Hawaiian Islands	200000	201632	131698	136689
Fiji Islands, exports	30000	30000	27000	10000
Total in Australia and Polynesia	340000	341632	285410	257835
Africa:				
Egypt, crop	95000	92000	90000	85111
Mauritius and other British possessions	150000	140000	115000	139751
Reunion and other French possessions	45000	44700	35300	37000
Total in Africa	290000	276700	240300	261862
Europe—Spain	20000	20000	20000	20000
Total cane-sugar production	2747500	2945811	3570413	3552374
Total beet-sugar production (Licht)	4900000	4323899	4792530	3889535
Grand total cane and beet sugar production	7707500	7269710	8362943	7441909
Estimated increase in the world's production	437790	.....	.....	.....

Digitized by Google

In the above table is comprised the entire sugar production of all the countries of the world, including those crops which have heretofore been ignored in statistics, but which have grown to amount in total to some 250,000 tons. These figures include local consumption of home production wherever known.

CONSUMPTION OF SUGAR IN THE UNITED STATES, 1894 TO 1897.

SOURCE OF SUGAR SUPPLY.	1896.	1895.	1894.
	Tons.	*Tons.*	*Tons.*
Meltings of the four ports	1508000	1464500	1545015
Of which were domestic from Louisiana crop	1411	23691	26261
	1506589	1440809	1518754
Meltings of foreign sugar through New Orleans	30520	19136	47772
Foreign refined in 1896, raws in 1894, through Galveston	2000	.....	2908
Foreign refined in raws through Pensacola	....	500	3642
Total	1539109	1460445	1573076
Export of raw sugar from Atlantic ports	11500	14070	19321
Export of refined sugar from Atlantic ports	3100	3937	3965
Total exports to be deducted	14600	18007	23286
Consumption of foreign sugar through Atlantic ports	1524509	1442438	1549790
Consumption of foreign sugar through San Francisco	146454	130000	150845
Total consumption of foreign sugar	1670963	1572438	1700635
Louisiana crop consumed during year	237720	317306	265836
Texas crop consumed during year	5500	7000	5000
Florida crop consumed during year	.....	200	500
Total consumption of domestic cane sugar	243220	324506	271336
California beet sugar crop	27300	21980	15665
Nebraska beet sugar crop	8000	4420	2653
Utah beet sugar crop	4700	3600	2102
Virginia beet sugar crop	....	.....	23
Consumption of domestic beet sugar	40000	30000	20443
Consumption of sorghum sugar	300	300	300
Consumption of maple sugar	5000	7500	5000
Molasses sugar made in United States from foreign molasses	603	15000	15000
Total consumption of all sugar	1960086	1949744	2012714

Consumption per capita is 62.72 pounds in 1896, 64.23 pounds in 1895, 66.64 pounds in 1894, 63 83 pounds in 1893, 63.76 pounds in 1892, 67.46 pounds in 1891, 54 56 pounds in 1890, 52.64 pounds in 1889. 54.23 pounds in 1888, 53.11 pounds in 1887, 52.55 pounds in 1886, 49.95 pounds in 1885, and 51 pounds in 1884.

CONSUMPTION OF SUGAR IN THE UNITED STATES DURING THE YEARS 1891 TO 1896, INCLUSIVE

YEAR.	Total Consumption of United States.	Increase (§) or Decrease (‖)	YEAR.	Total Consumption of United States	Increase (§) or Decrease (‖)
	Tons.	*Per Cent.*		*Tons.*	*Per Cent.*
1896	1960086	§ 0.53	1888	1457264	§ 4.62
1895	1949744	‖ 3.27	1887	1392909	§ 2.73
1894	2012714	§ 5.08	1886	1355809	§ 8.11
1893	1906862	§ 2.83	1885	1254116	§ 0.14
1892	1853470	‖ 1.102	1884	1252366	§ 7.0
1891	1872400	§ 22.96	1883	1170375	§ 10.3
1890	1522731	§ 5.80	1882	1061220	§ 6 8
1889	1439701	‖ 1.21	1881	993582	....

Increase for fifteen years, 97.3 per cent, or 6.49 per cent per annum.

Digitized by Google

FACTS ABOUT ALFALFA.

I. CHEMICAL COMPOSITION OF THE PLANT.

Alfalfa is one of that class of plants known as nitrogen collectors; but its chemical composition varies according to the soil upon which it is grown, in both mineral constituents and organic compounds. Analyses of the ashes of alfalfa grown on granitic soil, on chalky soil with flints, on clayey soil with chalk, and on very chalky soils, show the following variation in the percentages of mineral compounds:

	Granitic soil.	Chalky soil with flints.	Clayey soil with chalk.	Very chalky soil.
	Per Cent.	*Per Cent.*	*Per Cent.*	*Per Cent.*
Silicic acid	0.99	0.41	0.47	0 58
Ferric oxide	.76	1.05	.29	.60
Magnesium carbonate	9.88	7.15	10.11	9.05
Calcium sulphate	4.50	3.04	7.51	6.80
Calcium phosphate	14.94	8.11	10.66	19.71
Calcium carbonate	13.42	48.15	49.68	30.19
Potassium carbonate	48.42	29 19	20.60	26.09
Potas. and sodium chlorides	6.67	2.90	.68	6.98

The quantity of mineral matter removed from the soil by 1,000 pounds of alfalfa, containing 14 per cent of water is: nitrogen, 23 pounds, and mineral ash, 87 pounds. The mineral ash is composed of 7.3 pounds phosphoric acid, 21.9 pounds of potash, 1.5 pounds soda, 34.9 pounds lime, 4.2 pounds magnesia, 4.9 pounds sulphuric acid, 8.2 pounds silica, 1.6 pounds oxide of iron, and 2.5 pounds chlorine.

II. IT SHOULD BE CUT EARLY WHEN WANTED FOR HAY.

The maximum of nitrogenous compounds in this plant is found in the early stages of its growth, and when it is wanted for hay it should be cut before it begins to bloom, as the albuminoids are the most valuable part. There is a constant decrease of albuminoid nitrogen from the time the buds first form until the seed is ripe, as was shown by analyses made at the Colorado Experiment Station in 1888, at four different stages of its growth. The following table exhibits the proportion of different constituents found at the several stages of growth:

	Cut June 4; beginning to bud.	Cut June 20; full bloom.	Cut July 13; bloom half turned.	Cut Sept. 11; fully ripened seed.
Water	8.11	9.37	9.59	8.56
Ash	11.62	11.68	11.90	8.43
Fat	3.61	3.34	3.85	3.92
Albuminoid nitrogen	18.19	15.22	12.87	11.67
Crude fiber	12.88	14.65	18.01	20 23
Nitrogen-free extract	45 59	45 74	43.78	47.18
	100	100	100	100

Digitized by Google

III. CONDENSED INFORMATION FOR GROWERS.

Alfalfa seed weighs 60 pounds to the bushel.

For hay crop, sow 20 to 30 pounds of seed per acre.

For a crop of seed, sow 14 to 18 pounds of seed per acre.

Sow clean seed.

North of the latitude of Washington, sow alfalfa in the spring, as soon as the ground is warm—from the middle of April to the middle of May. Sow in drills or broadcast.

In the South and Southwest, and in California, sow alfalfa in spring or autumn. Sow in drills. In the South sow in drills 16 to 20 inches apart, and cultivate the first season.

Do not cover the seed too deep.

Alfalfa does not attain maturity until the third or fourth year; therefore, do not sow it expecting to get the best results in less than that time.

Alfalfa grows best on a deep, sandy loam, underlaid by a loose and permeable subsoil. It will not grow if there is an excess of water in the soil. The land must be well drained.

Alfalfa is a deep feeder. Plow the land thoroughly; the deeper the better.

Alfalfa thrives best in soils containing lime, potash, and magnesium It does not grow well in soils containing an excess of iron, or where lime is wholly absent.

Cut for hay when the first flowers appear. If cut in full bloom the hay will be woody and less nutritious.

Cut for seed when the middle clusters of seed pods are dark brown.

To make alfalfa hay, cut in the forenoon and let it wilt, then rake into windrows. It should be cured in windrows and cocks, and stacked or put in barns with as little handling as possible. Great care is required in order to get it in stack before the leaves become too dry and brittle. The leaves are the most palatable and nutritious part of the hay.

Cover the stacks with caps. This will prevent loss by molding when it rains.

In the arid regions, where irrigation is practiced, put water on the field before sowing the seed, and immediately after cutting each crop of hay.

It is not safe to pasture either cattle or sheep on alfalfa, as they are liable to bloat when it is fed green. Feed them the hay, or practice soiling.

There is no better or cheaper way of growing hogs than to pasture them on alfalfa. One acre will furnish pasturage for from ten to twenty hogs per season.

Horses can be pastured on alfalfa. There is no better hay for work animals, or for young, growing stock.

Alfalfa hay is not a complete ration. The best results are got by feeding it with corn fodder, ensilage, wheat or oat straw, or roots. Alfalfa contains large amounts of protein, which goes to form blood, bone, and muscle. It is deficient in the carbohydrates, namely, starch, fats, and cellulose, or fibre. These must be added to the ration or a part of the protein will be wasted.

Digitized by Google

To rid a field of alfalfa plow in midsummer, turning up the roots to the hot sun. Or, if the field can be irrigated, let the water stand on it two or three days in midsummer. This will rot the roots, and after the water has been drained off the field can be plowed.

Do not cut alfalfa too late in the season.

Do not let water stand on a field more than forty-eight hours.

Alfalfa hay, properly cured, has about the same value as red clover hay. The yield is much greater. It can be cut from three or four to seven or eight times in a season, and yields from a ton to a ton and half or more at a cutting.

Six to ten bushels of seed is the usual yield per acre.

Keep the weeds mowed and raked off the first season, or they will choke out the young alfalfa.

Sow alone, without any nurse crop. The latter is often just as harmful as the weeds.

Screen alfalfa seed before sowing, to separate the dodder and other weed seeds. Dodder or love vine is the worst enemy of alfalfa. Prevention is better than cure.

NEBRASKA MORTGAGE INDEBTEDNESS.

The state mortgage report for the first six months of 1897 as compiled by the state bureau of labor and statistics shows the number of farm mortgages filed was 6,589, amounting to $6,267,374.55. The number released was 8,001, amounting to $7,210.740.69. There were 2,182 town and city mortgages filed, amounting to $1,883,175.58, and 2,996 released, amounting to $3,198,173.35. The report in detail, showing the mortgage record by counties, is as follows:

COUNTY.	FARM MORTGAGES.		TOWN AND CITY.	
	Filed.	Satisfied.	Filed.	Satisfied.
Adams	$ 92611 43	$ 148825 39	$ 17298 90	$ 105857 96
Antelope	44121 00	66651 00	.....	.....
Blaine	290 00	400 00	.....	.....
Boone	94590 91	119607 62	6785 00	30532 28
Box Butte	11429 15	12775 13	6411 00	8069 22
Boyd	2001 17	850 00	350 00	300 00
Brown	5220 38	15774 13	1090 50	8626 43
Buffalo	76972 64	152739 88	12580 52	75075 78
Burt	128524 42	196369 48	9528 00	12826 44
Butler	124870 48	164692 63	16750 75	8889 10
Cass	226527 00	231177 00	12377 00	45142 00
Cedar	12:064 57	134588 09	10845 13	14802 00
Chase	2830 40	15236 29	572 00	1200 00
Cherry	16995 66	10759 23	5705 00	5550 00
Cheyenne	18118 00	4955 00	1431 00	6320 00
Clay	76396 39	86180 63	19677 65	10809 44
Colfax	134970 29	150453 77	10150 33	9839 80
Cuming	186000 93	190735 19	14084 48	12660 03
Custer	43190 00	92689 47	.....	.....
Dakota	46602 73	45825 01	5205 88	2125 00
Dawes	7891 32	32451 26	6915 35	42207 03
Dawson	50442 50	34911 92	6796 78	3351 40
Deuel	7263 75	8955 07	.....	.....

Digitized by Google

NEBRASKA MORTGAGE INDEBTEDNESS—*Continued.*

COUNTY.	FARM MORTGAGES.		TOWN AND CITY.	
	Filed.	Satisfied.	Filed.	Satisfied.
Dixon	$ 120472 44	$ 103896 30	$ 15924 25	$ 25564 30
Dodge	155174 54	150996 63	45199 43	101487 25
Douglas	133822 05	82855 46	867896 02	1572254 99
Dundy	4118 19	9875 00	.....	537 00
Fillmore	102192 61	100874 80	4988 30	13052 90
Franklin	37609 42	64412 70	2557 00	7682 86
Frontier	13970 00	18075 00	1418 15	1002 00
Furnas	33540 68	42706 14	5594 75	12825 25
Gage	210346 00	247989 00	23005 00	87932 00
Garfield	6132 35	5297 50	275 00	591 85
Gosper	18306 99	27862 89	.....	.....
Grant	.....	.....	.....	.....
Greeley	15233 35	16030 95	1153 00	800 00
Hall	51175 70	103194 03	58614 08	119157 89
Hamilton	134808 98	1474 5 90	4903 30	4047 28
Harlan	37439 18	32866 46	20688 23	6971 65
Hayes	9671 99	12005 20	.....	.....
Hitchcock	4229 00	11347 00	2200 00	300 00
Holt	124988 48	130518 10	2947 00	11488 00
Hooker	.....	.....	.....	.....
Howard	37289 00	44306 93	2198 32	1689 50
Jefferson	142020 60	138284 92	139 5 45	24065 90
Johnson	104457 53	119664 63	11070 50	14103 14
Kearney	87463 00	94367 37	8925 17	13798 34
Keith	6056 55	9655 00	600 00	500 00
Keya Paha	3941 00	8065 57	.....	75 00
Kimball	1000 00	.....	.....	.....
Knox	70093 95	88447 02	6879 20	6640 00
Lancaster	221177 59	233566 36	268454 29	292619 99
Lincoln	94887 80	40596 47	15499 01	33930 81
Logan	399 00	3640 00	.....	.....
Loup	1108 04	6229 94	250 00	.....
Madison	101885 80	120917 53	32783 73	37723 19
McPherson	1640 00	.....	.....	.....
Merrick	57231 93	76886 94	3334 10	7408 46
Nance	39093 51	51119 95	5662 41	13860 62
Nemaha	93011 95	87600 36	14985 03	11165 00
Nuckolls	38066 75	57660 20	5808 49	13441 85
Otoe	189766 77	191292 23	30356 99	33863 36
Pawnee	88070 18	83777 19	6896 02	21881 73
Perkins	12688 46	23616 00	.....	.....
Phelps	68767 12	97942 45	5848 35	9105 60
Pierce	49044 35	40279 62	5573 95	3784 50
Platte	193122 91	277048 53	24647 90	35568 80
Polk	131189 80	151089 70	8655 40	12314 14
Red Willow	17687 41	38349 13	9840 48	13807 56
Richardson	151824 90	177022 60	27112 45	25432 40
Rock	8117 65	15125 90	.....	35 00
Saline	207470 43	221427 05	18303 70	56693 67
Sarpy	148773 13	116140 40	3053 62	7880 00
Saunders	223502 81	189814 56	21385 77	11881 79
Scott's Bluff	5053 80	5274 00	2275 00	382 30
Seward	161021 91	200658 04	10826 35	11147 80
Sheridan	12167 23	12125 03	1202 43	3654 50
Sherman	44784 06	33481 15	1111 16	2130 00
Sioux	1105 00	3715 97	.....	.....
Stanton	77647 55	97116 76	6018 79	10982 95
Thayer	99411 31	131027 58	11357 45	14929 44
Thomas	.....	.....	.....	.....
Thurston	5350 00	3950 53	4407 98	4675 00
Valley	37928 28	82398 60	3818 00	9885 87
Washington	171039 00	183273 00	26815 00	19346 00
Wayne	124015 73	126754 46	15217 75	11867 96
Webster	73088 69	53933 63	5739 66	7038 75
Wheeler	4270 00	7138 65	.....	.....
York	128521 97	201062 56	20356 50	29039 68
Total	$ 6267874 55	$ 7210740 69	$ 1883176 38	$ 3198173 35

Digitized by Google

[As relating to farm mortgages proper in Nebraska it is found that fully 75 per cent is for the purchase of additional land, and for improvement of lands. Further, that farmer bank deposits and other forms of farmer loans equal 50 per cent of the farm mortgages.—*Ed.*]

FACTS ABOUT SILOS AND SILAGE.

From estimates published by the experiment stations it is gathered that a silo 15x15 feet and 20 feet deep (capacity 100 tons) can be built for $151.25, or $1.51 per ton of silo capacity; one 14x24 feet and 30 feet deep (capacity 180 tons) for $344.44, or $1.91 per ton of silo capacity; a round one, 20 feet diameter and 30 feet deep (capacity 180 tons) for $246.59, or $1.34 per ton of silo capacity; and a round one 23 feet diameter and 25 feet deep (capacity 208 tons) for $298.98, or $1.43 per ton of silo capacity.

COMPOSITION OF DIFFERENT KINDS OF SILOS.

MATERIAL.	Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Corn silage	79.1	1.4	1.7	6.	11.	0.8
Sorghum silage	76.1	1.1	.8	6.4	15.3	.3
Red clover silage	72	2.6	4.2	8.4	11.6	1.2
Soja bean silage	74.2	2.8	4.1	9.7	6.9	2.2
Cowpea vine silage	79.3	2.9	2.7	6.	7.6	1.5
Field pea vine silage	50.1	3.5	5.9	13.	26.	1.6
Silage of mixture of cowpea and soja bean vines	69.8	4.5	3.8	9.5	11.1	1.3

DIGESTIBLE MATTER IN 100 POUNDS OF CORN FODDER AND CORN SILAGE.

MATERIALS.	Dry Matter.	Protein.	Carbo-hydrates.	Fat.
Corn fodder, green	20.7 lbs.	1.10 lbs.	12.08 lbs.	0.37 lbs.
Corn silage	20.9 "	.56 "	11.79 "	.65 "
Corn fodder, dry	57.8 "	2.48 "	33.38 "	1.15 "

COMPOSITION OF CORN AND CLOVER BEFORE AND AFTER ENSILING.

MATERIALS.	Water.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Corn fodder, green	79.3	1.8	5	12.2	0.5
Corn silage	79.1	1.7	6	11	.8
Red clover, green	70.8	4.4	8.1	13.5	1.1
Clover silage	72	4.2	8.4	11.6	1.2

Digitized by Google

DIGESTIBLE MATTER IN CORN FROM ONE ACRE.

INGREDIENTS.	Green Fodder.	Silage.	Field-cured Fodder.
	Pounds.	Pounds.	Pounds.
Albuminoids	184	82	133
Non-albuminoids	67	151	69
Carbohydrates	3947	3164	3030
Fat	153	263	156
Total digestible substance	4351	3660	3388

EFFECTS ON QUANTITY OF MILK AND BUTTER THROUGH FEEDING SILAGE TO DAIRY CATTLE.

	EFFECT ON	
	Milk.	Butter.
No change	22	1
Improved in quantity and quality	95	18
Decreased in quantity and deteriorated in quality	1	...
Increased quantity	93	13
Decreased quantity	5	2
Improved quality	34	26
Deteriorated quality	5	3
Improved quality and decreased quantity	4	...
Increased quantity and deteriorated quality	5	...
Favorable results (whether in quantity or quality not stated)	30	15
Unfavorable results	...	1

PRACTICAL CONCLUSIONS ABOUT SILAGE.

From a practical standpoint, the value of silage as a food may be shown in several ways. It is as easily digested as the same plant preserved dry. It keeps the digestive system in a state of healthy activity, thereby aiding digestion. It is generally considered that horses and cattle fed silage show the beneficial effects of this food in the more healthy condition of the skin, as evidenced in its pliable, mellow condition, and the softness and luster of the coat of hair. Animals usually eat sound silage with a relish, and reject it only when decay is present. For milch cattle it seems especially well adapted, and the silo has proved an important and economical addition to the dairy farm.

Though not extensively used for the purpose, silage forms a valuable addition to the rations of sheep, and serves as a good and cheap substitute for roots. Its use as food for swine has not been successful.

Silage provides succulent food for farm animals at a time of year when vegetation is dead, and so, in a large degree, replaces pasturage.

It is not desirable or advisable to depend on silage alone for rough food. It should be fed only in a limited way in connection with hay and grain. For matured cattle, twenty-five to thirty-five pounds per day is a reasonable allowance. Horses should have less, and sheep only two or three pounds each.

Digitized by Google

Of the green fodders suited to silage, Indian corn, all things considered, is best and cheapest.

The proper time to harvest any green crop for silage is at maturity, before the leaves turn brown, and when the water content of the plant begins to diminish.

Generally speaking, three tons of silage are equal in feeding value to one ton of hay. On this basis a much larger amount of digestible food can be secured from an acre of silage corn than from an acre of hay. The food equivalent of four tons of hay per acre can easily be produced on an acre of land planted to corn.

The silo provides a more economical and compact method of storing fodder than does the haymow. A silo of 180 tons capacity, which will contain forty-four tons of dry matter, will hold less than twenty-three tons of red clover hay containing less than twenty tons of dry matter. The advantage of storage capacity clearly rests with the silo. The silo is especially adapted to intensive farming, where land is costly and storage space limited.

A carelessly constructed silo is an extravagance. A well made one is, therefore, an economy, and temporary ones are not advisable.

WOLFF'S FEEDING STANDARDS.

Numbers of feeding experiments have been made, under varying conditions, to ascertain the requirements of different kinds of farm animals. From these have been worked out feeding standards which show the amounts of digestible protein, fat, and carbohydrates supposed to be best adapted to different animals, when kept for different purposes. Those of Wolff, a German investigator, are regarded as most reliable.

A—PER DAY AND PER 1,000 POUNDS LIVE WEIGHT.

	Total organic matter.	DIGESTIBLE FOOD MATERIALS.			Fuel value.
		Protein.	Carbohydrates.	Fat.	
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Calories.*
Oxen at rest in stall	17.5	0.7	8.0	0.15	16815
Wool sheep, coarser breeds	20 0	1.2	10.8	0.20	22285
Wool sheep, finer breeds	22.5	1.5	11.4	0.25	25050
Oxen moderately worked	24.0	1.6	11.3	0.30	24260
Oxen heavily worked	26.0	2.4	13.2	0.50	13126
Horses moderately worked	22.5	1.8	11.2	0.60	26712
Horses heavily worked	25.5	2 8	13.4	0.80	33508
Milch cows	24.0	2.5	12.5	0.40	29590
Fattening steers:					
First period	27.0	2.5	15.0	0.50	34660
Second period	26.0	3.0	14.8	0.70	36062
Third period	25.0	2.7	14.8	0.60	35082
Fattening sheep:					
First period	26.0	3.0	15.2	0.50	35962
Second period	25.9	3.5	14.4	0.60	35826
Fattening swine:					
First period	36.0	5.0	27.5		60450
Second period	31.0	4.0	24.0		52080
Third period	23.5	2.7	17.5		37570

Digitized by Google

B—PER DAY AND PER HEAD.

	Average live weight per head.	Total Organic matter.	DIGESTIBLE FOOD MATERIALS.			Fuel value.
			Protein.	Carbohydrates.	Fat.	
Growing Cattle:						
Age—	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds*	*Calories.*
2 to 3 months	150	3.3	0.6	2.1	0.30	5116
3 to 6 months	300	7.0	1.0	4.1	0.30	10750
6 to 12 months	500	12.0	1.3	6.8	0 30	16332
12 to 18 months	700	16.8	1.4	9.1	0.28	20712
18 to 24 months	850	20.4	1.4	10.3	0.26	22859
Growing sheep:						
Age—						
5 to 6 months	56	1.6	0.18	0.87	0.045	2143
6 to 8 months	67	1.7	0.17	0.85	0.040	2066
8 to 11 months	75	1.7	0.16	0.85	0.037	2035
11 to 15 months	82	1.8	0.14	0.89	0.032	2051
15 to 20 months	85	1.9	0.12	0.88	0.025	1966
Growing fat swine:						
Age—						
2 to 3 months	50	2.1	0 38	1.50		3496
3 to 5 months	100	3.4	0 50	2 50		5580
5 to 6 months	125	3.9	0.54	2.96		6510
6 to 8 months	170	4.6	0.58	3.47		7533
8 to 12 months	250	5.2	0.62	4.05		8686

WHEAT AS COMPARED WITH CORN FOR FEEDING ANIMALS.

NUTRIENTS IN A BUSHEL OF EACH.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Fuel value.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds*	*Calories.*
56 pounds of corn	49.90	4.44	37.34	2.40	87827
60 pounds of wheat	53.70	6.14	41.53	1.01	92909

DRY MATTER AND DIGESTIBLE FOOD INGREDIENTS IN 100 POUNDS OF VARIOUS FEEDING STUFFS.

This table, taken in connection with the preceding ones, will enable the reader to make practical application of the information.

FEEDING STUFF.	Dry matter.	Protein.	Carbohydrates	Fat	Fuel value.
Green fodder:	*Pounds.*	*Pounds.*	*Pounds*	*Pounds.*	*Calories.*
Corn fodder† (average of all varieties)	20.7	1.10	12.08	0.37	26076
Rye fodder	23.4	2.05	14.11	0.44	31914
Oat fodder	37.8	2.69	22.66	1.04	51624
Redtop, in bloom	34.7	2.06	21.24	0.58	45785
Orchard grass, in bloom	27.0	1.91	15.91	0.58	35593
Meadow fescue, in bloom	30.1	1.49	16.78	0.42	34755
Timothy §, at different stages	38.4	2.28	23.71	0.77	51591
Kentucky blue grass	34.9	3.01	19 83	0.83	45985
Hungarian grass	28.9	1.92	15.63	0.36	34162
Red clover, at different stages	29.2	3.07	14.82	0 69	36187
Crimson clover	19.3	2.16	9.31	0.44	23191
Alfalfa ¶, at different stages	28.2	3.89	11.20	0.41	29798
Cowpea	16 4	1.68	8.08	0 25	19209
Soja bean	28.5	2.79	11.82	0.68	29383

†Corn fodder is entire plant, usually sown thick. § Herd's grass of New England and New York. ¶ Lucern.

Digitized by Google

DRY MATTER AND DIGESTIBLE FOOD INGREDIENTS—*Continued.*

FEEDING STUFF.	Dry matter.	Protein.	Carbo-hydrates	Fat.	Fuel value.
	Pounds	*Pounds*	*Pounds.*	*Pounds.*	*Ca ories.*
Corn silage	20.9	0.56	11.79	0.65	25714
Corn fodder †, field cured	57.8	2.48	33.38	1.15	71554
Corn stover, field cured	59.5	1.98	33.16	0.57	67766
Hay from—					
Orchard grass	90.1	4.78	41.99	1.40	92900
Redtop	91.1	4.82	46.83	0.95	100078
Timothy § (all analyses)	86.8	2.89	43.72	1.43	92729
Kentucky blue grass	78.8	4.76	37.31	1.95	86516
Hungarian grass	92.3	4.50	51.67	1.34	110131
Meadow fescue	80.0	4 20	43.34	1.73	95725
Mixed grasses	87.1	4.22	43.26	1.33	93925
Rowen (mixed)	83.4	7.19	41.20	1.43	96040
Mixed grasses and clover	87.1	6.16	42.71	1.46	97059
Red clover	84.7	6.58	35.35	1.66	84995
Alsike clover	90.3	8.15	41.70	1.36	98460
White clover	90.3	11.46	41.82	1.48	105346
Crimson clover	91.4	10.49	38.13	1.19	95877
Alfalfa ¶	91.6	10.58	37.33	1.38	94936
Cowpea	89.3	10.79	38.40	1.51	97865
Soja bean	88.7	10.78	38.72	1.54	98568
Wheat straw	90.4	0 80	37.94	0.46	73998
Rye straw	92.9	0.74	42.71	0.35	82294
Oat straw	90.8	1.58	41.63	0.74	83493
Soja bean straw	89.9	2.30	39.98	1.01	82987
Roots and tubers:					
Potatoes	21.1	1.27	15 59	.....	31360
Beets	13.0	1.21	8 84	0.05	18904
Mangel-wurzels	9.1	1.03	5.65	0.11	12888
Turnips	9.5	0.81	6.46	0.11	13986
Ruta-bagas	11.4	0.88	7.74	0.11	16497
Carrots	11.4	0.81	7.83	0.22	16999
Grains and other seeds:					
Corn (average of dent and flint)	89.1	7.92	66.69	4.28	156836
Barley	89.1	8.69	64.83	1.60	143499
Oats	89.0	9.25	48.34	4.18	124757
Rye	88.4	9.12	69.73	1.86	152400
Wheat (all varieties)	89.5	10.23	69.21	1.68	154848
Cotton seed (whole)	89.7	11.08	33.13	18.41	160047
Mill products:					
Corn meal	85.0	7.01	65.20	3.25	148026
Corn-and-cob meal	84.9	6.46	56.28	2.87	128808
Oat meal	92.1	11.53	52.06	5.93	143302
Barley meal	88.1	7.36	62.88	1.96	138818
Ground corn and ears, equal parts	88.1	7.39	61.20	3.72	143276
Pea meal	89.5	16.77	51.78	0.65	130246
Waste products:					
Gluten feed	92.2	20.40	43.75	8.59	155569
Gluten meal	91.2	25.49	42.32	10.38	169930
Hominy chops	88.9	7.45	55.24	6.81	145342
Malt sprouts	89.8	18.72	43.50	1.16	120624
Brewers' grains (wet)	24.3	4.00	9.37	1.38	306926
Brewers' grains (dried)	91.1	14.73	36.60	4.82	115814
Rye bran	88.4	11.45	50.28	1.96	123089
Wheat bran, all analyses	88.5	12.01	41.23	2.87	111138
Wheat middlings	84.0	12.79	53.15	3 40	136996
Wheat shorts	88.2	12.22	49.98	3.83	131855
Buckwheat middlings	86 8	17.34	26.58	4.54	108850
Cotton seed meal	91.8	37 01	16.52	12.58	152653
Cotton seed hulls	88.9	0.42	30.95	1.69	65480
Linseed meal (old process)	90.8	28 76	32.81	7.06	144313
Linseed meal (new process)	89.8	27.89	36.36	2.73	131026
Peanut meal	89.3	42.94	22.82	6.86	151263
Milk and its by-products:					
Whole milk	12.8	3.48	4.77	3.70	30866
Skim milk—cream raised by setting	9.6	3.13	4.69	0.83	18048
cream raised by separator	9.4	2 94	5.24	0.29	16439
Buttermilk	9.9	3.87	4.00	1.06	37685
Whey	6 6	0.84	4.74	0.31	11687

†Corn fodder is entire plant, usually sown thick. § Herd's grass of New England and New York. ¶ Lucern.

Digitized by Google

The last column in the above table, headed "fuel value," indicates the heat and energy power of the food. It will be remembered that one of the primary functions of the food is to produce heat for the body and energy for work. The value of food for this purpose is measured in "heat units" or "calories",† and is calculated from the nutrients digested. Thus the fuel value of one pound of digestible fat is estimated to be 4,220 calories, and of one pound of digestible protein or carbohydrates about 1,860 calories. The total fuel value of a feeding stuff is found by using these factors.

RATION FOR DAIRY COW.

	Total dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Fuel value.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Calories.*
12 pounds clover hay, 20 pounds corn silage, 4 pounds corn meal, and four pounds wheat bran	21.28	1.66	10.86	0.57	25709
4 pounds gluten feed	3.60	0.82	1.75	0.34	6223
Total	24.97	2.48	12.16	0 91	31932

NUTRIENTS IN RATION FOR YOUNG PIGS.

	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Fuel value.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Calories.*
10 pounds of skim milk	0.96	0.31	0.47	0.08	1805
1¼ pounds corn meal	1.06	0.09	0.82	0.04	1850
Total	2.02	0.40	1.29	0.12	3655
Standard for pig weighing 50 pounds	2.10	0.33	1.50		3496

SOME PRACTICAL FACTS ABOUT IRRIGATION.

I. Fertilizing Value of Irrigation Waters.

An example of the amounts and kinds of material which would be added to an acre of land where even exceptionally pure river water is used to a depth of two feet is furnished by a chemical analysis of the water of Delaware river and twelve New Jersey streams, as follows:

(*a*) MATERIALS IN 24 ACRE-INCHES OF DELAWARE RIVER WATER.

	Pounds.
Calcium carbonate	242.60
Magnesium carbonate	166.16
Potassium carbonate	31.74

† A calorie of heat is the amount required to raise the temperature of a pound of water about 40° F.

Digitized by Google

	Pounds.
Sodium chloride	20.54
Potassium chloride	1.86
Lime sulphate	35.48
Lime phosphate	26.14
Silica	93.34
Ferric oxide	5.60
Organic matter containing ammonia	117.62
Total	741.08

(*b*) NITROGEN COMPOUND IN 24 ACRE-INCHES OF WATER FROM 12 NEW JERSEY RIVERS.

	Pounds.
Free ammonia	15.63
Albuminoid ammonia	81.12
Nitrates	772.67
Nitrites	0.86
Total	870.28

II. Lifting Water by Wind Power.

Where the areas to be irrigated are small, and particularly where the lift is very low, the windmill makes a cheap and effective motor for lifting water, and it is well to consider what work can be done by piston pumps under different conditions, as in the following tables:

(*a*) NUMBER OF DAYS REQUIRED TO PUMP 2 AND 4 ACRE-INCHES OF WATER WITH A SINGLE-ACTING PISTON PUMP WORKING 8 HOURS PER DAY AND MAKING 30 STROKES PER MINUTE.

DIAMETER OF PISTON.	TIME REQUIRED TO PUMP 2 ACRE-INCHES WITH—		TIME REQUIRED TO PUMP 4 ACRE INCHES WITH—	
	6 inch stroke.	12 inch stroke.	6 inch stroke.	12 inch stroke.
Inches.	*Days.*	*Days.*	*Days.*	*Days.*
3	20.5	10.3	41.1	20.5
4	11.6	5.8	23.1	11.6
5	7.4	3.7	14.8	7.4
6	5.1	2.6	10.3	5.1
7	3.8	1.9	7.6	3.8
8	2.9	1.4	5.8	2.9
9	2.3	1.1	4.6	2.3
10	1.8	0.9	3.7	1.9
11	1.5	0.8	3.1	1.5
12	1.3	0.6	2.6	1.3

Digitized by Google

(*b*) AREAS IRRIGATED BY WINDMILLS WORKING SINGLE-ACTING PISTONS 8 HOURS PER DAY AT THE RATE OF 30 STROKES PER MINUTE.

DIAMETER OF PISTON.	2 INCHES EVERY 10 DAYS.		4 INCHES EVERY 10 DAYS.	
	6 inch stroke.	12 inch stroke.	6 inch stroke.	12 inch stroke.
Inches.	*Acres.*	*Acres.*	*Acres.*	*Acres.*
3	0.49	0.97	0.24	0.49
4	0.87	1.73	0.43	0.87
5	1.35	2.70	0.68	1.35
6	1.95	3.89	0.97	1.95
7	2.65	5.30	1.33	2.65
8	3.46	6.92	1.73	3.46
9	4.38	8.76	2.19	4 38
10	5.41	10.82	2.70	5.41
11	6.55	13.09	3.27	6.55
12	7.79	15.58	3.89	7.76

(*c*) NUMBER OF ACRES A FIRST-CLASS WINDMILL WILL IRRIGATE 2 AND 4 INCHES DEEP EVERY 10 DAYS WHEN WORKING 8 HOURS PER DAY AND LIFTING THE WATER 10, 15, AND 25 FEET RESPECTIVELY.

DIAMETER OF WINDMILL WHEEL	LIFT OF 10 FEET.		LIFT OF 15 FEET.		LIFT OF 25 FEET.	
	2 inches.	4 inches.	2 inches.	4 inches.	2 inches.	4 inches.
Feet	*Acres.*	*Acres.*	*Acres.*	*Acres.*	*Acres.*	*Acres.*
8.5	1.35	0 67	0.90	0.45	0.55	0.27
10	4.27	2.13	2.85	1.42	1.70	0.85
12	7.66	3.83	5 11	2.55	3.00	1.50
14	9.87	4.93	6.58	3.29	3.99	1.99
16	13.79	6.89	9.19	4.59	5.71	2.85
18	22.09	11.04	14.14	7.07	8 64	4.32
20	27.36	13 68	18.25	9.12	11 04	5.52
25	47.06	23 53	31.38	15.69	18.77	9.38
30	95.46	47.73	64 42	32.21	38.08	19.04

MIXTURES FOR PLANT AND FRUIT DISEASES.

I. THE BORDEAUX MIXTURE.

Water.....50 gallons
Copper sulphate..... 6 pounds
Unslacked lime..... 4 pounds

How to Prepare it.—In a cask holding somewhat over fifty gallons, put twenty-five gallons of water. Tie the six pounds of copper sulphate in a piece of coarse gunny sack and suspend it from a stick laid across the top of the cask so that it will hang just beneath the surface of the water. Slack in a suitable vessel the four pounds of lime, so as to obtain a smooth paste, free from lumps and grit. To do this use but a little water at first say three pints. When the lime begins to crack and crumble and the water to disappear add another quart or more, exercising care that the

Digitized by Google

lime at no time gets too dry. Toward the last considerable water will be required, but if added carefully and slowly a perfectly smooth paste will be obtained, provided, of course, the lime is of good quality. When the lime is slacked add sufficient water to the paste to bring the whole up to twenty-five gallons. When the copper sulphate is entirely dissolved and the lime is cool, pour the lime milk and copper sulphate solution slowly together into a barrel holding fifty gallons. The milk of lime should be thoroughly stirred before pouring. The method described insures good mixing, but to complete this work the barrel of liquid should receive a final stirring, for at least three minutes, with a broad wooden paddle.

II. STOCK SOLUTIONS OF LIME AND COPPER.

If spraying is to be done on a large scale, it will be found much more convenient and economical in every way to prepare what are known as stock solutions of both the copper and lime. To prepare a stock solution of copper sulphate, procure a barrel holding fifty gallons. Weigh out 100 pounds of copper sulphate, and after tying it in a sack suspend it so that it will hang as near the top of the barrel as possible. Fill the barrel with water, and in two or three days the copper will be dissolved. Now remove the sack and add enough water to bring the solution again up to the fifty gallon mark, previously made on the barrel. It will be understood, of course, that this second adding of water is merely to replace the space previously occupied by the sack and the crystals of copper sulphate. Each gallon of the solution thus made will contain two pounds of copper sulphate, and, under all ordinary conditions of temperature, there will be no material recrystallization, so that the stock preparation may be kept indefinitely.

Stock lime may be prepared in much the same way as the copper sulphate solution. Procure a barrel holding fifty gallons, making a mark to indicate the fifty-gallon point. Weigh out 100 pounds of fresh lime, place it in the barrel, and slack it. When slacked, add sufficient water to bring the whole mass up to fifty gallons. Each gallon of this preparation contains, after thorough stirring, two pounds of lime.

When it is desired to make bordeaux mixture of the fifty-gallon formula t is only necessary to measure out three gallons of the stock copper solution, and, after thorough stirring, 2 gallons of the stock lime; dilute each to twenty-five gallons, mix, stir, and test as already described.

III. AMMONIACAL SOLUTION OF COPPER CARBONATE.

This preparation, as now generally used, contains:

Water	45 gallons
Strong aqua ammonia	3 pints
Copper carbonate	5 ounces

The copper carbonate is first made into a thin paste by adding a pint and a half of water. The ammonia water is then slowly added, and if of the proper strength, *i.e.*, 26 degrees, a clear, deep-blue solution is obtained, which does not become cloudy when diluted to forty-five gallons.

Digitized by Google

The ammoniacal solution of copper carbonate being a clear liquid, its presence on the leaves, fruit, and other parts of the treated plants is not so noticeable as where the preparations containing lime are used.

In case it is desired to keep the strong solution as a stock preparation, the bottle or jug in which it is placed should be tightly corked.

IV. SPRAYING APPARATUS.

These consist in general of knapsack pumps, hand pumps, and horse-power sprayers. The knapsack pumps are designed especially for low-growing crops, such as grapes, nursery stock, etc. The hand-power pumps can be used in a great number of ways, and if strong and durable are probably the most useful of all the various styles of apparatus. The horse-power sprayers are designed to be drawn by one or more horses and operated by the same means. All these machines must be provided with nozzles that will furnish a mist-like spray and at the same time be easy to clean of any obstruction that may clog the necessarily small opening. There is no form of nozzle that so well fills these requirements as the Vermorel, which is now sold with nearly all spraying outfits.

SORGHUM AS A FORAGE CROP.

INGREDIENTS OF SORGHUM SEED AS COMPARED WITH INDIAN CORN.

	Number of analyses.	Air-dry Substance.						Water-free Substance.				
		Water.	Ash.	Fiber.	Fat.	Protein.	Nitrogen-free extract.	Ash.	Fiber.	Fat.	Protein.	Nitrogen-free extract.
Corn (shelled, all varieties)	208	10.9	1.5	2.1	5.4	10.5	69.6	1.7	2.4	6 1	11.7	78.1
Sorghum seed.....	10	12.8	2.1	2.6	3.6	9.1	70.0	2.4	3.0	4.1	10.4	80.1

Many stockmen who have had experience in feeding the seed claim that it is worth about 90 per cent as much as corn.

Digitized by Google

COMPOSITION OF THE SORGHUM PLANT AS COMPARED WITH KAFFIR AND INDIAN CORN.

PARTS OF PLANTS.	Air-dry Material,						Water-free Substance.				
	Water.	Protein.	Fat.	Nitrogen-free Extract.	Cellulose.	Ash.	Protein.	Fat.	Nitrogen-free Extract.	Cellulose.	Ash.
Whole Plant:											
Amber cane (in bloom)..	43.62	3.91	3.34	25.74	20.21	3.18	6.94	5.92	45.65	35.85	5.64
Link's hybrid (in bloom)	47.20	4.41	3.01	22.81	19.20	3.37	8.35	5.70	43.21	36.36	6.38
Amber cane (seed in dough)	41.70	3.17	2.93	32.22	17.03	2.95	5.44	5.03	55.26	29.21	5.06
Link's hybrid (seed in dough)	38.60	2.41	2.82	32.45	20.39	3.33	3.93	4.60	52.84	33.20	5.43
Seed Heads:											
Amber cane (seeds ripe).	20.15	7.04	3.08	58.42	8.82	2.49	8.81	3.86	73.16	11.05	3 12
Link's hybrid (seeds ripe)	19.90	9.11	3.46	52.25	12.34	2.94	11.38	4.32	65.23	15.40	3.67
Stalk:											
Amber cane (final cutting	35.72	2.98	3.29	35.96	19.36	2.74	4.56	5.12	55.95	30.11	4.26
Link's hybrid (final cutting	35.40	1.86	1.39	40.05	17.73	3.57	2.88	2.15	62.00	27.45	5.52
Leaves:											
Varieties not stated.....	12.43	9.60	4.55	44.93	23.93	4.56	10.96	5.19	51.31	27.33	5.21
Silage:											
Orange cane (average of 3 analyses)	80.94	.97	1.13	8.72	6.93	1.30	5.14	5.87	45 82	36.35	6.83
Kaffir corn (average of 3 analyses	67.20	2.10	1.40	15.17	11.20	2.88	6.39	4.31	46.18	34.32	8.79
Mixed sorghum (average of 17 analyses)	75.50	1.55	1.19	11.85	8.04	1.87	6.37	4.77	48.42	32.80	7.64
Corn silage (average of 99 analyses	79.10	1.70	.80	11.10	6.00	1.40	8.00	3.80	53.00	28.70	6.60
Fresh Material:											
Sweet sorghums (average of 31 analyses)	72.66	1.44	1.66	15.10	7.40	1.62	5.30	6.05	55.52	27.18	5.94
Waste:											
Sorghum bagasse (dry).	11.25	3.44	1.44	50.47	50.52	2.88	3.87	1.62	56.87	34.40	3.24

	Crude cellulose.	Crude fat.	Crude protein.	Extract matter.
Whole Plant.				
Early Amber cane, average, cut just after bloom	42	67	40	71
Sorghum (variety not stated) cut while in blossom	75	81	53	76
Dent corn, cut while kernels were glazing	51	78	54	75
Leaves.				
Sorghum, dry material	70	47	61	65
Corn leaves, partially dry	69	59	45	63
Waste.				
Sorghum bagasse, dry material	64	46	14	65

Digitized by Google

FERTILIZING VALUE OF FEEDING STUFFS.

	Value of nitrogen in 1 ton.	Value of phosphoric acid in 1 ton.	Value of potash in 1 ton.	Total fertilizing value per ton.
Corn meal	$ 4 53	$ 83	$ 31	$ 5 66
Corn silage	78	14	32	1 24
Crimson clover (green)	1 29	16	44	1 89
Crimson clover hay	6 63	82	2 26	9 71
Red clover hay	5 70	54	1 31	7 55
Gluten meal	15 09	39	05	15 53
Cottonseed meal	20 85	3 66	1 65	26 16
Linseed meal	16 08	2 28	99	19 36
Meat scrap	29 01	6 01	67	35 69
Wheat	7 08	96	45	8 49
Oats	5 36	90	45	6 70
Skim milk	1 74	26	1 08	2 11
Timothy hay	3 00	43	1 17	4 60
Wheat bran	7 56	3 40	1 34	12 30
Wheat straw	81	30	1 02	2 18
Turnips	48	14	34	96

From 50 to 95 per cent of fertilizing constituents of food is recovered in the manure, depending upon the kind of animal fed.

FERTILIZING VALUE OF FARM PRODUCTS.

It should be clearly understood that when the farmer sells meat, milk grain, hay, fruits, vegetables, etc., from his farm, or neglects to save and use the manure produced, he removes from his soil a certain amount of potash, phosphoric acid, and nitrogen that must be restored sooner or later if productiveness is to be maintained.

The following table compiled by Armsby shows the amount and value of fertilizing constituents carried away from the soil in different products:

	Pounds per ton.			Value per ton.				Manurial value of $10 worth.
	Nitrogen.	Phosphoric acid.	Potash.	Nitrogen.	Phosphoric acid.	Potash.	Total.	
Meadow hay	20.42	8.2	26.4	$ 3.47	$ .57	$ 1.06	$ 5.10	$ 5.10
Clover hay	40.16	11.2	36.6	6.83	.78	1.46	9.07	9.07
Potatoes	7.01	3.2	11.4	1.19	.22	.46	1.87	.12
Wheat bran	49.15	54.6	28.6	8.35	3.82	1.14	13.31	8.32
Linseed meal	105.12	32.2	24.8	17.87	2.25	.99	21.11	7.54
Cotton seed meal	135.65	56.2	29.2	23.06	3.93	1.17	28.16	10.05
Wheat	37.53	15.8	10.6	6.38	1.11	.42	7.91	2.63
Oats	36.42	12.4	8.8	6.21	.87	.35	7.43	3.86
Corn	33.06	11.8	7.4	5.62	.83	.30	6.75	3.78
Barley	39.65	15.4	9.0	6.74	1.08	.36	8.18	3.03
Milk	10.20	3.4	3.0	1.73	.24	.12	2.09	.88
Cheese	90.60	23 0	5.0	15.40	1.61	.20	17.21	.69
Live cattle	53.20	37.2	3.4	9.04	2.60	.14	11.78	1.18

We learn from the above table that the farmer who sells a ton of hay, for example, sells in this ton of hay fertilizing ingredients which, if purchased in the form of commercial fertilizers, would cost him about $5.10; that if he sells 2,000 pounds of wheat he sells an amount of nitrogen, phos-

Digitized by Google

phoric acid, and potash which it would cost him $7.91 to replace in his soil in the form of commercial fertilizers. Or, looking at it from a somewhat different standpoint, a farmer who sells, for example, $10 worth of wheat sells with it about $2.63 worth of the fertility of his soil. In other words, when he receives his $10 this amount does not represent the net receipts of the transaction, for he has parted with $2.63 worth of capital, that is, of the stored-up fertility of his soil, and if he does not take this into the account he makes the same mistake a merchant would should he estimate his profits by the amount of cash which he received and neglect to take account of stock.

AMOUNT AND VALUE OF MANURE PRODUCED PER 1,000 POUNDS, OF LIVE WEIGHT OF DIFFERENT ANIMALS.

The following table compiled from a bulletin of the New York Cornell Station shows the amount and value of manure produced by the principal kinds of farm animals fed liberally, and given sufficient bedding to keep them clean, calculated to a uniform basis of 1,000 pounds live weight:

	AMOUNT PER DAY.	VALUE PER DAY.*	VALUE PER YEAR.*
	Pounds	*Cents.*	
Sheep	34.1	7.2	$26.00
Calves	67.8	6.2	24.45
Pigs	83.6	16.7	60.88
Cows	74.1	8.0	29.27
Horses	48.8	7.6	27.74

The fertilizing constituents and the value per ton of the manure obtained under the above conditions are shown in the following table, in which is inserted for comparison the results of analyses by Storer of manure of hens, which is representative of fowls in general:

ANALYSIS AND VALUE PER TON OF MANURE OF DIFFERENT ANIMALS.

	WATER.	NITROGEN.	PHOSPHORIC ACID.	POTASH.	VALUE PER TON.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	
Sheep	59.52	0.768	0.391	0.591	$3.30
Calves	77.73	0.497	0.172	0.532	2.18
Pigs	74.13	0.840	0.390	0.320	3.29
Cows	75.25	0.426	0.290	0.440	2.02
Horses	48.69	0.490	0.260	0.480	2.21
Hen manure	56.00	0.80 to 2	0.50 to 2	0.80 to .90	7.07

These figures probably fairly represent the actual fertilizing value of the carefully preserved manure (both solid and liquid) of well fed and cared for animals. In all cases the manure was protected from leaching

* Valuing nitrogen at 15 cents, phosphoric acid at 6 cents, and potash at 4½ cents per pound.

Digitized by Google

and in some cases treated with a small amount of gypsum as a preservative. "It will be noticed that the average amount of nitrogen recovered in all the manure is considerably more than that of the potash and about twice the amount of phosphoric acid.

In general practice the manure from the different kinds of animals is frequently collected in a common heap until needed. While it is difficult to state an average, mixed barnyard manure properly cared for may be safely assumed to vary in composition within the following limits:

	PER CENT.
Nitrogen varies from	0.4 to 0.75
Phosphoric acid varies from	0.2 to 0.40
Potash varies from	0.4 to 0.75
Water varies from	70 to 80

KAFFIR CORN.

ITS CHARACTER, VARIETIES, ETC.

This is an African cereal which was distributed by the Department of Agriculture about ten years ago all over the United States. It belongs to the same group of plants as broom-corn and other non-saccharine sorghums. The reports of trials made with it are generally favorable. It has proved to be a valuable food for domestic fowls and for stock. There are three varieties of it in cultivation in this country, the red, the white, and the black-hulled white (or African millet). Its drouth-resisting qualities are much greater than those of Indian Corn.

YIELD PER ACRE AS COMPARED WITH INDIAN CORN.

VARIETY.	Grain.	Fodder.
	Bushels.	*Tons.*
Red Kaffir corn	58.25	6.05
White Kaffir corn	32.55	5.33
Indian corn	45.50	3.07

GAINS BY HOGS FED ON KAFFIR CORN, AS COMPARED WITH OTHER FOODS.

TIME, NUMBER, ETC.	LOT NO. 1. Kaffir Corn Meal.	LOT NO. 2. Kaffir Corn Meal and Soja bean Meal.	LOT NO. 3. Indian Corn Meal.	LOT NO. 4. Indian Corn Meal and Soja bean Meal.
Gain of lot, 77 days	110.50 lbs.	380.00 lbs.	184 00 lbs.	384.50 lbs.
Daily gain per pig	0.47 lbs	1.64 lbs.	0.79 lbs.	1.65 lbs.
Food eaten per pound of gain	6.48 lbs.	3.51 lbs.	4.88 lbs.	3.23 lbs.

Digitized by Google

FOOD CONSTITUENTS IN KAFFIR CORN AND INDIAN CORN.

	IN FRESH OR AIR-DRY MATERIAL.						AUTHORITY.
	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.	
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per cent.*	*Per ct.*	
Kaffir corn (whole plant, green	76.13	1.75	3.22	6.16	11.96	0.78	Penn. station.
Do	76.05	1.44	2.34	8.36	11.41	0.40	N. York Cornell station.
Average	76.09	1.60	2.78	7.26	11.69	0.59	
Corn (whole plant, green)	79.30	1.20	1.80	5.00	12.20	0.50	
Kaffir corn fodder (whole plant)	10.94	5.48	3.31	30.37	47.40	2.50	N. C. station.
Corn fodder (whole plant)	†11.00	4.16	6.93	22.02	53.43	2.46	
Kaffir corn fodder (without heads)	8.67	7.14	4.89	28.02	49.75	1.53	Kansas station.
Corn stover (without ears)	§9.00	5.20	5.81	30.12	48.19	1.68	
Kaffir corn (mature head)	16.23	2.02	6.92	6.79	65.18	2.86	N. C. station.
Corn ears (corn and cob meal)	15.10	1.50	8.50	6.60	64.80	3.50	
Kaffir corn seed	9.31	1.53	9.92	1.35	74.92	2.97	Kansas station.
Corn kernels	10.90	1.50	10.50	2.10	69.60	5.40	
Kaffir corn flour	16 75	2.18	6.62	1.16	69.47	3.82	N. C. station.
Corn meal	15.00	1.40	9.20	1.90	68.70	3.80	

COST OF RAISING A BUSHEL OF WHEAT.

We are frequently asked the question: "What does it cost to raise a bushel of corn, wheat, rye, barley, oats," etc., etc. A reply is: "It depends entirely on who raises them." The aim of fair work is to secure maximum results with minimum toil and expenditure. Premiums are offered "*for the best.*"

Here is a statement as to the cost of a bushel of wheat and rye, from a reliable, painstaking, intelligent, systematic farmer in Nebraska, one who "keeps books," hence knows just what he is doing; nothing "haphazard" with Mr. Underwood:

DANBURY, NEB., February 1, 1898.

As requested, I append herewith the cost of raising 4,627 bushels of wheat and 300 bushels of rye, on the Northwest quarter of section 7-1-27, located two miles North of Danbury, Nebraska:

SOWING.

176 bushels of wheat at 45 cents	$ 29 20
16 bushels of rye at 20 cents	3 20
2 men drilling 13 days	18 00
Board of men at $1.50 per week	6 00
Feed of teams	3 50
	$109 90

† Assumed: Field-cured corn fodder contains on an average 42 2 per cent of water.
§ Assumed: Field-cured corn stover contains on an average 40.5 per cent of water.

Digitized by Google

BREAKING STALKS.

Breaking stalks, 1 man 8 days	$ 6 00
Board	1 50
Feed of team	75
	$ 8 25

HARVESTING.

Heading	$ 80 00
6 men 8 days	50 50
Boarding men	10 50
Feeding teams	5 00
	$146 00

THRESHING.

Machine	$105 00
10 men 5 days	50 00
1 man 3 days	3 00
5 teams 5 days	37 50
Board of men 5 days	20 25
Feeding teams	4 00
	$219 73
Interest on cost of land $800, at 10 per cent	$ 80 00
Taxes	13 00
	$ 93 00
Grand total	$576 90

Net cost per bushel, 11⅛ cents.

I had two men working for me by the month at $18 per month and board. After seeding was over I figured these men at $1 per day, the same as I paid other hands in the harvest field and for threshing.

C. P. UNDERWOOD.

Digitized by Google

REPORTS OF THE SCIENTISTS.

Digitized by Google

Digitized by Google

REPORT OF THE BOTANIST.

By Charles E. Bessey, Ph.D.

Gentlemen of the Nebraska State Board of Agriculture:

I herewith present my Twelfth Annual Report as your official botanist for the year 1897.

GRASSES AT THE STATE FAIR.

The exhibit of grasses at the fair of 1897 was unprecedented, and great care was taken to arrange them in an artistic and instructive manner. I have never seen finer exhibits anywhere, and I feel that the state is to be congratulated upon possessing so many men who show so much ability in the gathering and preparation of such fine collections. When I compare the twenty-one fine collections in the last fair with the few, small and badly arranged exhibits made when the Board first offered a premium upon collections of grasses, I feel that great progress has been made. The people of Nebraska now not only know a great many grasses, but they have learned how to make tasteful and attractive displays of these important native plants.

The laborious task of running over the great number of specimens was assigned to two senior students of the University of Nebraska, Messrs. W. T. Horne and J. A. Warren, who have for some time been giving especial attention to the study of the grasses. I wish here to thank them for the very efficient manner in which they performed this tedious work.

The number of collections examined was twenty-one, and the total number of specimens was 1,501. The details of these collections are shown in the following table:

EXHIBITS.	True grasses.	Clovers.	Sedges.	Other plants.	Totals.
Brown county	67	6	26	7	106
Cherry county	14	1	1	1	17
Cuming county	45	5	11	3	64
Dawes county	17	1	1	1	20
Dawson county	30	4	4	1	39
Douglas county (1)	33	2	4	..	39
Douglas county (2)	104	4	36	5	149
Douglas county (3)	40	2	9	4	55
Douglas county (4)	42	2	8	..	52
Dundy county	45	2	10	2	59
Fillmore county	49	4	7	1	61
Frontier county	43	4	8	..	55
Kearney county	82	..	..	1	83

Digitized by Google

EXHIBITS.	True grasses.	Clovers.	Sedges.	Other plants.	Totals.
Knox county	37	3	7	2	49
Merrick county	23	3	2	..	28
Saline county	83	5	18	2	108
Sioux county	55	2	15	6	78
Thayer county	73	8	38	5	124
Valley county	44	..	19	3	66
Washington county	112	5	26	4	147
York county	71	8	19	4	102
Totals	1109	71	269	52	1501

It may be profitable to notice the distribution of these collections with reference to the natural divisions of the state, as follows:

REGION I.—WOODED BLUFFS AND MEADOW-LANDS.

1. Missouri District.
   Five collections (Douglas and Washington counties). 442

REGION II. THE PRAIRIES.

1. Elkhorn District.
   Two collections (Cuming and Knox counties) 113
2. Platte District.
   Four collections (Boone, Dawson, Merrick, and Valley counties.).....239
3. Blue River District.
   Four collections (Fillmore, Saline, Thayer, and York counties)...395

REGION III. THE SAND-HILLS.

1. Niobrara District.
   One collection (Cherry county).....17
2. Republican District.
   Three collections (Dundy, Frontier, and Kearney counties).....214

REGION IV. THE FOOT-HILLS.

1. Pine Ridge District.
   Two collections (Dawes and Sioux counties).....98

By regions alone, these collections aggregate as follows:

I. Wooded Bluffs and Meadow-lands.....442
II. The Prairies 747
III. The Sand-hills 214
IV. The Foot-hills.....98

It will be noticed that I have again included in the forage plants which are brought for exhibition along with the true grasses and the clovers, many kinds of sedges. I am convinced that the botanical prejudice against the sedges as forage plants is, to a large extent, groundless. It appears to be true that some species of sedges are of little value for forage, but this is quite true also of the grasses.

In order to satisfy myself upon this point I have taken pains to compare the chemical analyses of a number of wild and cultivated grasses, clovers, and sedges. Taking seven wild grasses, namely, Switch grass (*Panicum virgatum*), Muhlenberg's grass of two species (*Muhlenbergia racemosa* and

Digitized by Google

M. mexicana), Blue Grama (*Bouteloua oligostachya*), Buffalo grass (*Bulbilis dactyloides*), Slough grass (*Beckmannia erucaeformis*), False Buffalo grass (*Munroa squarrosa*), I find that the relative values range from 111 to 145, the former for False Buffalo grass, and the latter for one of the Muhlenberg's grasses. Timothy stands at 127, red clover and alfalfa are respectively 136 and 125, while millet is 137. Now by the same mode of comparison I find that five common sedges range from 123 to 146.

While I know very well that the chemical analysis alone of a plant can not decide its food-value, yet these figures tell this much, namely, that there are nutritious matters in the sedges in fully as large amounts as in the grasses and other common forage plants. When a farmer finds his stock eating sedges, he need not be afraid that they will not obtain nutritious food. Whenever an animal is found to relish a particular kind of sedge, we may be pretty sure that it will obtain as much nutrition from it as from the average grass. I am convinced that more attention should be given to the sedges and other plants as possible sources of forage plants for cultivation.

THE BOTANICAL REGIONS AND DISTRICTS OF NEBRASKA.

During the past few years so much work has been done upon the native flora of the state that it is now possible to map the botanical features with considerable accuracy. In a work which is just appearing *, Dr. Pound and Mr. Clements find that four of the botanical "Regions" of North America extend across the state as irregular belts of different and varying widths. The accompanying map will serve to show the general boundaries of these Regions. They may be described as follows :†

I. THE WOODED-BLUFF AND MEADOW-LAND REGION.—This region occupies in our territory a narrow strip about 35 kilometers (22 miles) wide, comprising that portion of the Missouri river valley lying in Nebraska. It is by no means confined to, nor is it characteristic of, Nebraska, but it extends eastward and southeastward into Iowa and Missouri, and thence farther eastward to the great Mississippi valley. In Nebraska it consists of broad lowlands, abrupt wooded bluffs with their numerous ravines, and back of these the higher meadows which gradually pass into the rolling prairies beyond. The native vegetation is still largely eastern, although in this region many of these eastern species find their extreme western boundary. Typically western species are wanting, or nearly so. Here we have still an abundance of forest trees, all of which have pushed westward from the larger forest areas of the Mississippi valley.

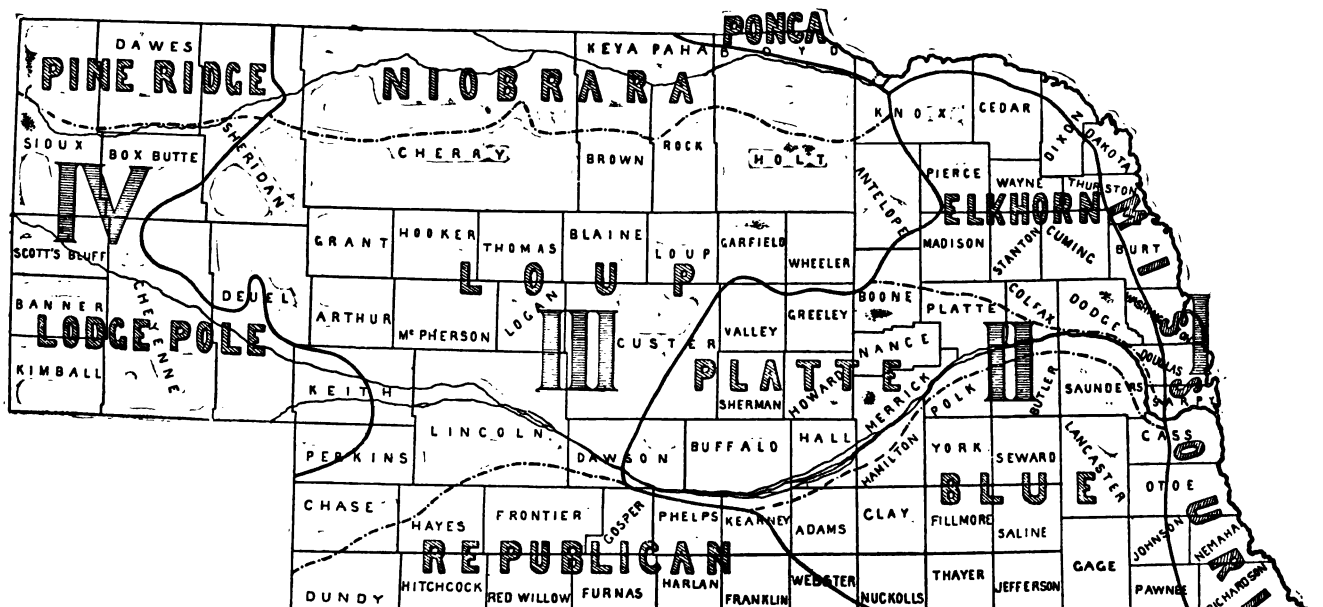
This region is separable into two "Districts," namely: (1) the Ponca District, which is a small extension from South Dakota; and (2) the Missouri District, which extends from the mouth of the Niobrara river southward beyond our borders.

---

* *The Phytogeography of Nebraska*, by Roscoe Pound, Ph.D., and Frederic E. Clements, A.M. Lincoln. North & Co., 1898.

† What follows regarding these Regions is taken with little change from the work cited.

Digitized by Google



MAP OF PHYTOGEOGRAPHICAL REGIONS AND DISTRICTS OF NEBRASKA.

Digitized by Google

II. THE PRAIRIE REGION.—This region occupies a broad belt immediately west of Region I, approximately 200 kilometers wide (125 miles). It extends from the northern part of the state southward into Kansas, Oklahoma, and the Indian Territory, and consists of rounded hills and frequent sloughs, interspersed with broad river valleys. Vegetatively it is characterized by the dominance of "prairie grasses" and the scattering or disappearing forests.

Three districts are quite easily marked out in this region as follows:

(1) The Elkhorn district in the north; (2) the Platte district along the Platte river in the center; and (3) the Blue river district in the south.

III. THE SAND-HILL REGION.—This Region lies directly beyond the Prairie Region, and is nearly 300 kilometers wide (189 miles). It extends northward into the Dakotas and southward and southwestward into Kansas, Colorado, Oklahoma, the Indian Territory, and Texas. The loose, sandy soil and the rounded hills with round-bottomed valleys between them are characteristic of this region. There is relatively little surface drainage, the valleys often including ponds at their lowest points. Vegetatively this Region is characterized by the dominance of "bunch grasses," the presence of blow-out grasses, and the peculiar vegetation of the sand-draws, and the entire absence of forests, the arboreous vegetation being reduced to mere fringes along the water courses.

Three "Districts" are recognized, namely: (1) The Niobrara District on the north; (2) the Loup District in the center; and (3) the Republican District on the south.

IV. THE FOOT-HILL REGION.—This is an extension of the Wyoming foot-hills into Nebraska. It occupies a broad belt 150 kilometers wide (90 to 95 miles) in the western part of the state. It consists of a high and undulating table-land, broken by numerous canyons, and dotted with frequent buttes. The great number of mountain plants which have extended eastward into or across this Region, and the prevalence of mat and rosette forming plants are characteristic. Two Districts may be recognized in Nebraska, namely: (1) The Pine Ridge District on the north; and (2) the Lodge Pole District on the south.

THE FORAGE PROBLEM IN EASTERN NEBRASKA.

In this discussion I shall refer to those portions of the state which are included in Regions I and II, described in the preceding pages, and as shown upon the map on page 110. In other words, I shall in this paper consider that Eastern Nebraska includes the territory covered by the Wooded Bluffs and Meadow-lands, and the Prairies.

1. *Disappearance of Wild Grasses Through Cultivation.*—It is scarcely necessary to call attention to the fact that the original wild grasses of eastern Nebraska are rapidly disappearing on account of the cultivation of the soil. Wherever the prairie sod is broken up and the soil kept under cultivation for a few years, the wild grasses entirely disappear. On many farms wild grasses still persist along the fences and by road-sides, but

Digitized by Google

even here in time close pasturing and the cutting of the sod by the tread of farm animals will eradicate the few remaining individuals. Buffalo Grass and Grama are now not to be found at all upon many farms where they were formerly abundant. The same may be said of many other species, which formerly yielded an abundance of pasturage. It may be stated positively that insofar as we have brought a considerable portion of the area of eastern Nebraska under the plow, we have eradicated the wild grasses, and to just this extent we have deprived stock of this source of forage.

2. *The "Wearing Out" of Wild Pastures.*—The wild grasses are disappearing not only on account of the cultivation of the soil, but also because of too heavy and injudicious pasturing. It seems to have been taken for granted that because the wild grasses were here from time immemorial, without any indication that they might ever "wear out," there was no danger of our injuring them by allowing stock to run over them in great numbers in all seasons and under all conditions. We know very well that a field of cultivated grass will not stand such treatment, but apparently we have not thought that it would make any difference whatever with the pastures of nature's sowing. We have been as profligate in our treatment of the natural pastures as our fathers were of the great forests of the Atlantic states. Here as there man acted as if that which nature planted was unworthy of being preserved. There our fathers found the ground covered with forests, which, if properly cared for, would have yielded untold wealth for ages to come, but blind to the future they ruthlessly destroyed what should have been left as a priceless heritage for their children. The wealth which it took centuries to grow was burned, to give place to the pittance which the farmer now gets from soil robbed of its forests. The old tragedy of Eden has been enacted over again. As man was put into the garden "to dress it, and to keep it," so ought he to have interpreted his work in the great garden of forest trees. He was not to destroy it, he was to dress it and to keep it. But he destroyed it, and again as in the old tragedy the ground is cursed for his sake, yea, it is cursed by man himself, through his own actions, and to-day in all that desolated land of former forests, but now of forests destroyed, it is true, as of old, that in sorrow man eats of the produce of the ground; that it brings forth thorns and thistles, and that all his life he is doomed to sweating toil to earn his daily bread.

We were not placed in an Eden of trees, but in a great garden of sweet grasses and brilliant flowers, a garden in which roamed and fed tens of thousands of wild creatures. We ought to have listened to the command "to dress it and to keep it." We ought to have improved these wild pastures so that they might have yielded many fold what they did before we cared for them. But like our fathers in the great forests we have destroyed what nature gave us, and now verily we often eat in sorrow of the produce of the ground.

We upon the plains can see the blind folly of those who destroyed the great forests in order to be able to plow the ground. We see that the

Digitized by Google

great crop of trees was of more value than the puny crops which man now grows with much labor and weariness. But while we see the folly of the forest destroyers, we are scarcely able to see that we, ourselves, have been guilty of similar shortsightedness in destroying our natural pastures and meadows. We have perhaps hopelessly destroyed nearly all the rich grazing ground of eastern Nebraska. We have worn out our wild pastures, and where succulent grasses grew there are now only bitter weeds. As of old, because of our folly, the ground is cursed for our sake, and it brings forth thorns and thistles.

3. *Over Production of Corn.*—For some reason which is difficult to make out, men who own land have for many years very generally preferred to do the harder work of plowing, planting, cultivating, harvesting, and threshing connected with corn and grain growing, instead of the much lighter and far more agreeable work of feeding and caring for live stock. We might as well face the fact that from the dawn of history down to the present the tiller of the soil has had the harder labor, while the shepherd and the herder have dwelt in comparative comfort, surrounded by their growing flocks and herds. It is my conviction that we have needlessly increased the hard labor of rural life. We dig, and plow, and toil in the hot sun more than we need. It is not a wise economy of human strength for a man to toil from spring to fall in gathering food for horses, cattle, sheep, and hogs. These creatures should be our servants, our helpers, but we have planned so unwisely that we are their slaves. The point I wish to emphasize is this: that the over production of corn results in a ceaseless round of toil with but little return in money, and less in the enjoyment of life.

4. *Our Neglect of the Perennial Forage Plants.*—Closely connected with the over-production of corn, and probably dependent upon it, is the too common neglect of those cultivated forage plants which live from year to year. It is too laborious and expensive to grow a field of hay for but a single season. The annual forage plants require relatively much more hard work than do the perennials. It is not too much to say that many men wear themselves out with the labor of securing annual forage crops, when with far less labor they might supply their stock with perennial crops. It is better to have a field of perennial Timothy than of annual Hungarian grass, even if the former does not yield half as many tons of hay. It is better to have a field of perennial grass of even less value than Timothy, if it year by year yields a fair amount of hay or pasture. Some of the coarser grasses, as the Oat-grasses and Brome-grasses, are far preferable to the more nutri tious annuals, like Hungarian grass, German millet, Crimson clover, etc. When we compare the forage plants of the eastern states with those of the West, and especially those of eastern Nebraska, we are struck by the much greater dependence which the western man places upon annuals. He thus adds greatly to his early spring labors, crowding still more that very busy season of the year.

5. *Our Neglect of Root-crops.*—In no particular have we neglected our opportunities to a greater degree for easily supplying our domestic ani-

Digitized by Google

mals with wholesome food, than in regard to such "root crops" as turnips, rutabagas, sugar beets, and artichokes. These are easily grown, and may be handled without excessive labor. No addition to the dry rations of the winter is more welcome than that which is made by these palatable roots and tubers. The extensive introduction of the sugar beet for sugar making is showing to many of our best feeders how valuable these sweet roots are for winter food for our domestic animals. In England the rutabaga and turnip have long been grown for feeding to stock in the autumn and winter, and this practice has been followed for some time in the eastern states. It ought to be more generally introduced in eastern Nebraska.

I want to say a word again in favor of the artichoke as a food for swine. It is not a proper ration that we deal out to swine when day after day we feed them upon dry corn. The hog is not exclusively a grain-eating animal. In a state of nature he eats grains, nuts, tubers, and roots. Now when we put him into a pen and feed him upon corn alone we severely tax his digestion. He wants some additional moist vegetable food, such as can be supplied very easily by the artichoke. There is no reason why the hog should not in this case harvest the food which he eats. If fed upon a good ration of corn and then allowed to forage in the artichoke field he would obtain needed exercise, and at the same time would add some important constituents to his food. Possibly in a given time the increase in weight might not be any more than under the corn diet with no exercise, but this is quite certain that the quality of the pork would be perceptibly improved.

6. *Our Neglect of Soiling Crops*—There are many easily grown crops which may be made to yield enormous weights of green forage. In my report a year ago I called attention to these, and need do no more now than to emphasize the fact that to too great an extent we ignore forage plants of this kind. The soiling crop to which I referred in my report last year was corn grown very thickly upon the ground, so as to have more slender stems, cane grown in the same way, field peas, which should be grown as a field crop, and cut as needed when green, and the leaves of cabbage, turnips, and similar crops.

Last year I called attention to the fact that experiments made at the Pennsylvania Experiment Station show that by means of soiling crops from three to five times as much digestible food per acre may be produced as upon a similar area when devoted to pasturage.

7. *We Need Steadier Practices in Agriculture.*—Our agricultural communities in eastern Nebraska have not yet learned to pursue an even, steady course year after year. It too often happens that in a community not enough care has been taken to grow a sufficient quantity of hay to feed the cattle which will be wintered in it. Next winter perhaps there will be a surplus of hay, due to two results which follow directly from the condition the previous winter. These are, first, that not so many cattle are fed the second winter, and, second, that more hay was grown. Both of these follow as a direct result of the shortage of hay the first winter. Very likely by the third winter we may have again a shortage of hay.

Digitized by Google

Now there is need of each man's maintaining his business with greater steadiness, since these violent fluctuations always result in heavy losses to the communities. There should be a general understanding throughout large communities which would enable every farmer to aid in maintaining the proper balance between the stock on the one hand, and the forage on which it is to be fed, on the other. Here is where the county agricultural societies might be of great service. Here, also, the more local farmers' institutes may do much good.

8. *We Need to Practice a Rotation of Crops.*—If, instead of planting and cropping our farms in a most irregular fashion, we were to have a regular and fixed rotation of crops the forage problem would be largely solved. Each farm should be a little kingdom in which in regular order each field is to be made to bear its share of the work of supplying the general needs. I do not here imply that the permanent pastures should be regularly plowed up so as to be put into crops of various kinds in succession. As I have said above, in my opinion, the longer a permanent pasture or meadow can be kept as such the better it will be for both the farmer and his animals. But for the fields which must come pretty regularly under the plow year by year there should be a well planned succession of crops, a rotation of crops so balanced that at no period of the rotation shall there be a troublesome surplus, or a still more troublesome deficit in those crops upon which our domestic animals depend. This is not the place in which to discuss the details of such a rotation, but my purpose is accomplished when I have shown that it is one of the factors in the solution of the forage problem.

THE FORAGE PROBLEM IN CENTRAL NEBRASKA.

The portion of the state to which I refer in this discussion is essentially that which is included in Region III of the map on page 110. Its general elevation is from 600 to 1,100 meters (2,000 to 3,600 feet) above sea level, and the surface is generally much diversified by rounded sandy and gravelly hills, between which are moist valleys. In the latter are rich grasses which often yield not only an abundance of pasture, but also great quantities of nutritious hay. The sides of the hills are more or less sparsely covered with bunch grasses which afford a nutritious, though dry and somewhat hard, food for stock. The forage problem in this portion of the state is sufficiently different from that in eastern Nebraska to warrant a separate treatment.

1. *The Natural Meadows.*—Along many of the streams of this region there are broad meadow-lands upon which annually there are grown large quantities of most excellent hay. These meadows are composed of mixtures of several kinds of wild grasses and sedges, which produce a hay of moderate fineness. Similar meadows of smaller area occur in the valleys between the hills, especially where the valleys contain ponds or small lakes. These natural meadows show us what may be done in many more places in central Nebraska by a little care on our part. There is little

Digitized by Google

question that by care the area of meadow land in this portion of the state could be increased many fold.

2. *The Grasses of the Hills.*—The bunch grasses of the hills to a large extent are quite nutritious. They are Turkey-foot grass (*Andropogon hallii*), Bunch grass proper (*Andropogon scoparius*), Big Blue stem (*Andropogon provincialis*), Switch grass (*Panicum virgatum*), near the lower sides of the hills, Bushy Blue stem (*Andropogon nutans*), Blue grama (*Bouteloua oligostachya*), Wild June grass (*Koeleria cristata*), Tall grama (*Bouteloua racemosa*), and Needle grass (*Stipa comata*). While these are not always bunch grasses they more commonly grow in bunches on the sides and summits of the drier hills. These afford good summer pasturage, but in the winter they are generally too harsh and dry for eating. Cattle must depend for their winter pasturage upon the grasses grown in the moister lowlands, or the enclosed valleys between the rounded hills.

3. *Improvement of the Hill Pastures.*—It is a question worth considering whether the hill pastures can be improved by care and proper treatment. Some inquiries and examination of the conditions of soil and present vegetation suggest that it is possible to considerably improve some portions of the hill pastures by the introduction of more nutritious and palatable forage plants. In one portion of these hill pastures white clover seed was sown upon the unbroken sod near the moister portions of the depressions in the hills. From this it spread upward to such an extent as to encourage the continuation of the experiments. In this way, by taking advantage of the moist condition of the soil in early spring, not only white clover but some of the strong and quick-growing grasses, like the oat-grasses and brome grasses might be added to the native vegetation of the hills.

4. *The Sand-Hills Should Not Be Plowed.*—In any attempts to improve the hill pastures, plowing should not be resorted to. The light soil when once stirred becomes covered with vegetation again with great difficulty and in some instances such denuded soil becomes an area of shifting sand. Even in wet seasons these sandy areas should not be plowed up, for although a crop may be grown, the risk is too great that some of the soil will remain uncovered until a dry season turns the sandy soil into a hot mass of shifting sand. All plowing in the sand hills proper should be confined to the valleys and depressions between the hills.

5. *Alfalfa for Central Nebraska.*—Wherever it is possible to irrigate the ground Alfalfa should be brought in. This sandy soil, with water added, will sustain immense crops of this admirable hay plant. Throughout central Nebraska there are hundreds of places where smaller or larger tracts of land may be irrigated for the purpose of growing Alfalfa. This work should be encouraged, both on account of the high quality of the forage which Alfalfa yields, but as well also on account of the large quantity which may be grown upon a given area.

6. *Irrigated Natural Meadows.*—I wish to call attention to the need of care in regard to the natural meadows upon irrigable lands. It is not

Digitized by Google

always the best policy to plow up a piece of wild land as soon as the water for irrigating it is available. Every man who has a good natural meadow of hay land should very carefully go over the whole question before he concludes to plow it up in order to make an Alfalfa field. A good Alfalfa field is a good thing—in fact it is a *very good* thing—but a good natural meadow under irrigation may be *very much better*. Let no man hastily plow under a permanent meadow of wild grasses without at least trying the effect of a year or two of judicious irrigation. Here, again, one may help matters by scattering the seeds of Oat-grasses and Brome-grasses, especially upon the areas where the wild grass is thin.

7. *The Coarser Fodder Plants.*—In order to help out the stock in the winter the coarser fodder plants may be grown in the small valleys and depressions lying between the hills. Here, where the moisture comes to within a short distance of the surface, in even the driest seasons, such plants as Fodder Corn, Kaffir Corn, Sugar Cane, etc., may be grown in sufficient quantities to be of material aid. The amount of these crops which may be grown upon small areas is so great that there is probably not a ranch or stock farm in even the driest part of the sand hills upon which it would not be possible to grow enough of these coarse fodders to carry the cattle safely through the winter.

THE FORAGE PROBLEM ON THE HIGH PLAINS.

The High Plains of Nebraska include very nearly that portion of the state which is designated on the map, on page 110, as the Foot-hill Region. Its surface is pretty generally more than 1,100 meters (3,600 feet) above sea-level, and from this altitude it reaches to about 1,600 meters (one mile) above the level of the sea. The general surface is rolling, with here and there a level stretch of land. In some places, as along Pine Ridge and Cheyenne Ridge, the abrupt elevations partake so strongly of the nature of mountains that they are often designated as such. Certain elevated knobs in the Cheyenne Ridge, between the Lodge Pole and North Platte Rivers, are commonly known as the Wild Cat Mountains. In this portion of the state the extreme sandiness, so characteristic of central Nebraska, is largely wanting. The ground is covered with a rather loose turf compound of Grama, Wheat Grass, and Needle Grass, with some admixture of Buffalo Grass, and the other small nutritious grasses so commonly associated with the latter. Here the species of cactuses abound, and in many places the repellent Dagger Weed. Here and there are great belts of sage brush of several species, with the related and associated Grease-wood. Water is scarce in many places, while in others it abounds, either in streams, or flowing from perennial springs. Rainfall is not abundant, and in the winter the fall of snow is usually not great, thus permitting stock to feed for the greater portion of the winter. The scanty rainfall permits the natural drying of the grasses in the fall, so that they constitute an edible forage all winter long—a kind of natural, uncut hay, which the cattle feed upon with great relish.

Digitized by Google

1. *The Usual Vegetation of the High Plains.*—When one travels over the high plains he is struck with the fact that there is a great sameness in the vegetation. One may often travel for hours without seeing a shrub or other woody plant of any kind. To say that the high plains are mostly treeless but partly expresses the fact that the vegetation is emphatically herbaceous. Hour after hour one travels over the undulating surface and finds nothing which casts a shadow large enough to shelter him from the glare of the noonday sun. Grass everywhere, on hill and in hollow, covers the surface as far as the eye can reach.

In an expedition made last summer across certain portions of the high plains I made careful observations upon the vegetation of the region, especially that which yields forage and supplies pasture to the herds of stock now happily quite abundant again. One thing impresses itself upon the student of the vegetation of the region, namely, not only the general absence of trees and shrubs, but the general absence of tall vegetation of any kind. The "weedy" appearance of the open country in the eastern part of Nebraska is quite absent from the rolling plains of the highlands of the West.

Four grasses abound, and give character to the vegetation, namely: (1) Buffalo Grass, which occurs in somewhat restricted patches, as is always the case with this species; (2) Blue Grama, which is pretty evenly scattered over the surface; (3) Wheat Grass, mingled with the foregoing; and, (4) Needle Grass, the latter being most conspicuous in the early part of the season. Of these I need not say much since they are pretty well known. Buffalo Grass is here, as everywhere else, a most valuable forage plant, not only as a summer pasture plant, but still more as a winter forage, its dry foliage constituting one of the most nutritious foods to be found anywhere. Blue Grama forms a loose sod of scattered plants, each plant bearing a tuft of fine leaves which are highly nutritious, and constitute a most important forage for summer and winter. The amount of forage supplied by Blue Grama is not as large as that from some other grasses, but its fine quality very largely compensates for the smaller yield. Wheat Grass is much coarser than either of the preceding, its stems being straight, stiff, and wiry, and its leaves rather strong and tough. However, it is quite nutritious, and it makes good pasture and still better hay. Its greatest fault is in its stiff, straight stems, bearing few leaves. The hay is, therefore, quite hard and stiff, and on account of its scattered habit of growth the yield is not large upon a given area. It has been my opinion for many years that if we could improve this grass so as to give it a closer habit of growth, thereby reducing its stem to a more slender structure, we should find it to be a most valuable and useful addition to the pasture and hay grasses for the central and western portions of the state. As it is, it is one of the grasses which makes grazing not only possible but profitable on the High Plains. With regard to Needle Grass, not so much can be said that is favorable. It is an early grass, and early in the season it affords nutritious and palatable food for stock. But later in the season, when it shoots up its tall stem, it is harsher, tougher, and much less palatable, and

Digitized by Google

when its sharp barbed "needles" form it is for a while a troublesome weed upon the cattle range, and a source of danger to the unshorn sheep.

2. *The Grasses of Moist Lands.*—Here and there upon the High Plains are moist tracts of land upon which a ranker grassy vegetation springs up every year. These tracts constitute natural meadows, which have been mown annually ever since the occupancy of the country by white men. Anyone crossing this country will find many stacks of most excellent hay made from the grasses and sedges of these meadows. An examination of several natural meadows shows that the vegetation is composed in part of the same species as those growing upon the adjacent higher and drier lands. Thus, while there is no Buffalo Grass on the moist land meadows, there is some Blue Grama, much Wheat Grass, and some Needle Grass. In addition, there are one or two rather tall-growing grasses having no common names, and several species of sedges. The moist lands along the river valleys are much like those just referred to, in fact, it appears that the meadows are but continuations of the grasses of the general surface into the better conditions afforded by the presence of a little more moisture in the soil. They show us what the high plains would be if it were possible to water them.

3. *The Irrigable Valleys.*—Across the high plains there flow several streams whose waters may be led out upon the adjacent flat lands. The largest of these is the great mountain torrent, the North Platte river, which rushes down from the Colorado and Wyoming mountains in an almost straight line from the Wyoming line across four counties, a distance of fully 240 kilometers (150 miles). Its valley contains an immense area of rich soil, all of which may be brought eventually under irrigation. The area of irrigable soil in this straight stretch of the North Platte valley is nearly, if not quite, as large as that of an ordinary county in eastern Nebraska. Here I have seen the natural grasses under the potent influence of water spring into such vigor as to promise a rich return in valuable hay. If no other increase in forage resulted from the application of water to this tract of country than the great increase in the wild hay crop from the natural meadows, I doubt not that it would well repay the expense of making the irrigation ditches. And it may be well at this point to call attention to the desirability of preserving many of those meadows instead of plowing them up. By care they may be much improved without the labor of plowing and seeding. I am confident that in a great many cases the return for the labor and money expended will be greater when the native grasses are permitted to remain instead of destroying them by plowing and then attempting to secure a good stand of cultivated grasses. We should not heedlessly destroy the well-sodded wild grass lands in the hope of securing better ones of the cultivated grasses.

I must not, however, convey the impression that it does not pay to plow the soil in this great valley. Far from it. I have seen such fine growths of Timothy, Red Clover, and Alfalfa that it is small wonder that the owners of the land long to turn under the wild grasses, in order to replace them by these well-known and tried forage plants. My plea is not against Timothy,

Digitized by Google

Red Clover, or Alfalfa, but that the farmer while providing himself with these good things retain also a reasonable share of the good wild grasses also.

I may close this paper with a reference to Alfalfa, and the part it should play in supplying forage to the stock upon the High Plains. It seems to me that eventually these higher lands will be very largely devoted to grazing, and that general agriculture will have to give way to the more profitable industry of stock growing. These great stretches of country can support millions of cattle and sheep during the summer, and the rich irrigable valleys seem destined to be used very largely for the supply of such additional forage as may be necessary to carry them through the winter. Here is where that admirable forage plant Alfalfa, with its ready adaptability to the conditions of irrigation, becomes of so much importance. With a good area of Alfalfa under irrigation in the western region the amount of stock may be very greatly increased. I look to see the great valley of the North Platte bear the same relation to the surrounding drier country that the fertile Nile valley does to Egypt. Here will be grown Alfalfa, Timothy, Clover, and the wild hay grasses, upon which the herds of cattle will be fed and fattened in the winter. Here, too, will be grown those crops for the supply of food for the men and their families who live here to care for their stock. Such a development of the industries of the High Plains will, in my opinion, eventually make this one of the richest and most prosperous portions of the state.

APPENDIX.

I here bring together some recent valuable papers published by the Division of Agrostology of the United States Department of Agriculture, based upon the personal observations of several well-known specialists, who have been studying the forage problems upon the prairies and plains. I feel warranted in giving these valuable papers wide publicity in Nebraska since I have found by personal experience how difficult it is to secure copies. The first paper, by Professor Pammel, of Iowa, is taken from Bulletin 9, of the Division of Agrostology, published late in 1897.

I. THE FORAGE PROBLEM IN NEBRASKA.

"The forage problem of Nebraska is one of peculiar interest. A great variety of native species occur because of the diversified climate and soils of the state. Observations were made in the vicinity of Omaha and thence southwest to Lincoln, Crete, Hastings, and McCook to the Colorado line. The rich, fertile bottoms along the Missouri, the rolling prairie west of Omaha, the fertile valleys of the Platte, Salt, and Blue rivers, the salt marshes in the vicinity of Lincoln, the vast stretch of level prairie about Hastings, the flood plain of the Republican river, with the rolling clay hills that rise from this valley, the narrow canyons, and the sand hills in the western part of the state are striking illustrations of the varied features of this region. Grazing is now, and ever will be, an im-

Digitized by Google

portant industry in the western half of the state. Although the grasses may not grow so luxuriantly season after season in Nebraska as in Iowa, the climate is more favorable for winter grazing than in the latter state, and there is a large number of valuable species of native forage plants.

"It will not be necessary to discuss the forage plants of eastern Nebraska, as the conditions are similar to those in western Iowa.

"In the central and western parts of the state the farmer relies chiefly on the native forage plants. I was unable to find a single introduced grass superior to Grama-grass, Wild Wheat, Turkey-foot, Big Blue Stem, and Buffalo-grass. I was strongly impressed with the fact that the grasses best adapted to this climate are the native species. In alluding to the value of our native grasses to obtain improved forms, Prof. F. Lamson-Scribner says:

"'Nearly all of our cultivated forage plants are of foreign origin, and if it were not simply a matter of public interest, it ought to be one of public sentiment to preserve for the coming generations of American farmers these native species which have added so much to the wealth of the land in the past. The species in the grazing regions in the West and Southwest, and, for that matter, in every part of this country where sheep or cattle are raised, are best adapted for the conditions under which each grass grows, and it is folly to think that better forms may be introduced from Europe or Asia or Australia, where climate and soil and abundance of rainfall are different. The meadow grasses of the parks, woodlands, and mountain slopes, the Grama and Buffalo grasses of the Southwest and the Blue stems of the eastern prairie belt, cannot be improved upon.

"'It certainly seems to me that the time has arrived for us to consider the advisability of saving from extermination the numerous valuable forage plants found in the arid and sub-arid portions of our country. The long-continued existence of these grasses shows that they are adapted to the climate in which they occur. For ages these valuable grasses have defied unfavorable climatic conditions and have stood the tramping and grazing of vast herds of buffaloes.'"

"Central Nebraska is very favorably situated for grazing. The soil in this section is productive, as is evidenced by the fine crops of corn and small grain which have been grown here under favorable climatic conditions. Influenced by these fine crops, settlers occupied the country and the valuable native turf was turned under and the land devoted to the growth of small cereals and corn. The results in many instances have been anything but satisfactory. No method of agriculture or human agency can control weather. The ordinary cultivated crops cannot be produced with a scant rainfall. The semi-arid belt is superb as a grazing country, unexcelled west of the Missouri. A crop of grass is just as certain here as corn is in eastern Nebraska. The climate is favorable for winter grazing, and stock will need little attention. The crop cannot be as large as under conditions of greater moisture, and the grazing lands must be kept under certain restrictions. Business men and intelligent farmers with whom I have conversed believe that the only salvation for this region is the

Digitized by Google

stock industry. It will take some years to again see the turf-forming grasses cover the field where the plow has destroyed the sod which was many seasons in forming. Some believe that they will never return. It requires time to re-establish a prairie, just as it does a forest, when once burned over, to become covered with trees again. Annuals appear first, some nearly worthless, but these prepare the way for the better perennials, like Blue-Stem and Grama."

In a recent paper in the Yearbook of the United States Department of Agriculture, Jared G. Smith, assistant agrostologist, discusses so well some of the problems taken up in this report that I feel it advisable to republish a portion of what he says in this connection as follows:

II. THE FORAGE QUESTION IN THE PRAIRIE STATES.

"The forage question in the prairie states practically resolves itself into Shall we raise more cattle upon the farm? or, opposed to that, Shall we plant more corn? A proper discussion of the subject of the forage conditions of the prairies states cannot be undertaken without a thorough understanding of the necessity that has arisen for the more extensive use of forage crops. The entire cattle and sheep industry is absolutely dependent upon the question of forage. The United States sells abroad about 350,000 head of fat cattle each year. The market is always open for a quality of beef better suited to the buyer's taste. An overstocking of the markets will never occur if we send only products of the best quality; and the best quality of beef, mutton, milk, butter, and cheese can be produced only by the proper use of the best forage crops. Viewed from this standpoint, the future for the cultivation of forage crops is very bright all through the prairie states.

"The prairies in their wild state were covered with the richest possible grass flora. There was no similar region that had so many useful species and so few poisonous or injurious ones. Almost any square mile of the whole extent of territory could furnish in one season fifty kinds of grasses and native forage plants, grasses that would make from one and a half to two tons of hay per acre as rich as that from an Old World meadow. It was a magnificent legacy to the rancher and the farmer. To the one is promised food for a million cattle; to the other it proved the golden possibilities of a soil that would bring forth bountiful harvests. But within the last thirty years all this has changed. We can no longer point to our broad prairies and say that the natural forage conditions here are the best in the world. Hardly an acre remains anywhere east of the ninety-seventh meridian that will still yield its ton and a half of prairie hay. There is hardly a square mile of prairie sod that will produce thirty kinds of native wild grasses and clovers per annum.

"The nutritious Mesquite and Buffalo grasses have been driven to occupy the waste lands along roadsides and railroad tracks, where they are rapidly being choked out and exterminated by weeds. Many of these wild grasses are superior in nutritious qualities, as shown by chemical analysis and digestive tests, to the cultivated or "tame" grasses of which we buy seeds

Digitized by Google

from foreign countries. Many of the native prairie species have seeds that are just as easy to harvest as those of timothy, rye grass, tall oat grass, and dozens of other tame species, but they have never been collected in sufficient quantities to place upon the market or to make long-continued tests as to their adaptability to cultivation. These wild species should be taken care of until we are sure that we have not something better. They are acclimated. They will endure drought and freezing and flooding and all the other climatic excesses to which they have been subject for centuries. They are the best grasses for the region, because they are the natives of the region. It behooves us to plant seeds of these prairie species before some foreign seedman sells them to us for their weight in gold, with the promise that they will yield a hundred tons of fodder to the acre.

"East of the ninety-seventh meridian the yearly precipitation averages from thirty to forty inches. This belt has been termed the "humid" prairie region, having sufficient rainfall nine years in every ten to insure fair crops. Here tame grasses and clover are uniformly successful. It is in the "arid" and "semi-arid" prairie belts that there is the greatest need of thorough and long-continued experiments with the grasses and forage plants. It is in the arid prairie region that native grasses will be especially valuable in cultivation, because they will not have to be acclimated.

"*The Arid Prairies.*

"Those portions of Kansas and Nebraska that lie west of the one hundredth meridian, and a considerable range of territory extending as far east as the ninety-seventh, constituting what is known as the arid and semi-arid belts, receive only from fifteen to twenty-two inches of rain per year. In the most favorable seasons these lands, which are exceedingly fertile, produce large crops of corn, wheat, and other cereals; but such favorable seasons are uncommon, the average for any series of years being only about two out of five, so that farming, in so far as it relates to the growing of cereals, yields only a bare living.

"The amount of water that the arid prairies receive would be sufficient if it were distributed uniformly through the winter and the growing season, or if it came in drizzling showers so that it would all be absorbed; but it usually comes in sudden torrents. A small amount is caught and held by the soil, and a larger amount is carried away by the streams. The arid and semi-arid lands vary from 1,500 to 3,000 feet in elevation. They were originally covered with a turf composed of buffalo, grama, mesquite, blue stem, and wild-wheat grasses, that formed an excellent natural pasture for the immense herds of buffalo, elk, and antelope, and later for the ranch cattle. These lands cannot be called agricultural. True, they have a rich soil and will yield bountiful crops under irrigation or in good seasons when the rainfall is properly distributed, but so long as these conditions are beyond control and cannot be supplied, the lands do not and will not compete with those of the more humid regions farther east. There may be isolated valleys all through this high prairie where

Digitized by Google

the "water table" stands so near to the surface that crops can send their roots down to it, and where the under-ground water is in quantity sufficient to be used for irrigating small patches, but the bulk of the lands cannot profitably be used for farming. It is a grazing and not a farming section.

"The close buffalo grass or grama sod sheds water as well as a shingle roof. The surface soil may become moist to the depth of two or three or four feet beneath such a sod; then for a great depth the subsoil is absolutely dry down to the water table, or point at which water may be obtained in wells. This was the condition of the plains of eastern Colorado at the time the first irrigation ditches were constructed, twenty years ago, and the same condition of affairs exists to-day through the whole arid region. It is well known that after the opening up of an irrigation ditch through such soil the absorption of water is enormous, and this soaking up of water continues until the subsoil is saturated to a depth of forty feet or more. It would take a hundred years to fill the subsoils of the arid region in this way if the water supply were available, which it is not.

"If it were desired to change western Kansas and Nebraska from a grazing to a farming region, the most practical way would be to break up every acre of the prairie sod to enable the ground to absorb more of the annual precipitation. If this were to be done, it would take perhaps ten years to saturate the subsoil to a sufficient depth. Such a course would be neither practicable nor desirable, as there is already too much land available for growing cereals. These high arid and semi-arid prairies are fine grazing lands, and will continue so for many years if they are properly treated.

"*Prairie Hay.*

"The yield of wild hay in the prairie region is far from uniform, depending, as it does, upon the amount and distribution of rainfall through the growing season. Hay meadows that are cut continuously for a number of years deteriorate rapidly, both as to yield and quality of hay. The latter depends upon the relative amount of weeds that the hay contains.

"Wild meadows are not given the same treatment as tame meadows. They are neither reseeded by the farmer nor allowed to reseed themselves. The natural result is that the vitality of the grasses is diminished and they are unable to hold their own against the weedy perennials that are so abundant in all prairies. These weeds increase so rapidly that they soon gain the upper hand and become more numerous than the grasses, and the meadow loses its value as hay land. Good hay land is worth anywhere in the West $10 to $20 per acre more than any other class of raw prairie. An average yield from such meadow land is a ton and a half to the acre. In exceptional seasons it often amounts to two or two and a half tons, while in years of drought it falls to a ton or less. The price of good prairie hay varies from $2.50 to $10 per ton, baled, at the railroad, according as the visible supply of hay varies throughout the United States.

"With such yearly yields, and at such prices, it will pay to improve the prairie meadows, so that the product shall not decrease in amount or de-

Digitized by Google

teriorate in quality. The wild hay grasses should be permitted to reseed themselves, if not one year in three, at least one in four or five. Cutting the grass early in the season would help to keep down the weeds. It is a matter of observation that the species of weeds which increase most rapidly in the hay fields are those that blossom and ripen their seeds before the hay is ready to cut. Their increase can be checked only by cutting them while they are in flower, and thus preventing the seed from ripening. The intermingled mass of weeds and grass along the sloughs and draws or on the ground where old stacks have stood should be mowed and burned, or at least raked off the field. Otherwise these weed patches will grow in size from year to year and reduce the yield of hay.

"The hay crop of the West is a money crop that annually brings in hundreds of thousands of dollars. As the acreage of raw prairie decreases the value of prairie hay will continue to increase, so that to properly care for the hay meadows and prolong their period of usefulness will become a paying investment.

"The prairies in their natural state were covered with an exceedingly rich grass flora. They were superb grazing grounds, clothed from early spring to late autumn with a succession of the most nutritious grasses, and in winter with standing hay as good as, or better, than tame hay. Forage was plentiful and cheap—to be had for the cost of gathering it. The early settler saw no need of cultivating grasses and clovers, for was there not at his very door better pasture and better hay land than he could get with his timothy and clover in many years at much labor and expense? Those who are interested in better forage conditions for the prairie states have continually to face this argument, even in sections where the best native grasses have been all but exterminated. Farmers in the West say that prairie hay is better and cheaper than tame hay, and if cattle will live through a winter on what they can pick up from the prairies, what is the use of planting all these forage crops? Such has undoubtedly been the state of affairs over the entire region, but it cannot last much longer, and if we want to be forehanded and prevent the great losses of livestock that occur every time there is a bad season, we must take time by the forelock. To depend upon the natural hay to carry a herd through the winter is trusting too much to chance. If there is a mild winter, without heavy snows, the cattle sometimes make a considerable gain in weight by the time grass starts in the spring.

"The occurrence of such a winter or series of winters always causes a boom in the cattle industry. But if the winter is severe, with heavy snows that do not drift, but lie evenly over the ground, cattle cannot pick up enough of this natural hay to more than sustain life, and the herd comes out poorer in spring by a good many tons' weight of fat and flesh. To make good beef and raise cattle at a profit it is necesary to keep the steer growing continuously from birth until it is ready for slaughter. The more rapid the growth, the sooner cattle can be turned off, and the quality of the beef will be better, commanding higher prices. The only

Digitized by Google

natural solution of this problem is to raise grasses and clovers so as to be able to supplement the scanty feed in periods of scarcity.

"Thus we see that the problem of improved forage conditions in the prairie region, whether looked at from the standpoint of the farmer or from that of the stockman, centers upon the one question, Shall we plant grasses? To this there can be but the one answer: As the cultivation of grasses and forage plants is at the foundation of agriculture, if we are to improve the quality of our farming lands and increase their capacity for production, we must devote more acres to grass. It is absolutely necessary to impress this fact upon the intelligent and progressive farmer.

"*Improvement of the Ranges.*

"There has been much written and said within the last ten years about the deterioration of the ranges. Cattlemen say that the grasses are not what they used to be; that the valuable perennial species are disappearing and that their place is being taken by less nutritious annuals. This is true in a very marked degree in many sections of the grazing country.

"The one great mistake in the treatment of the cattle ranges, the one which always proves most disastrous from a financial standpoint, is overstocking. It is something which must always be guarded against. The maximum number of cattle that can safely be carried on any square mile of territory is the number that the land will support during a poor season. Whenever this rule is ignored there is bound to be loss. The present shortage of cattle all through the West is due to the fact that the ranges were stocked up to the limit that they would carry during the series of exceptionally favorable grass years preceding the years of drought. Then followed a series of bad years, when the native perennial grasses did not get rain enough to more than keep them alive. The cattle on the breeding grounds of the West and Southwest died by thousands from thirst and starvation. It may seem like throwing away money not to have all the grass eaten down, but in the long run there will be more profit if there are fewer head carried per square mile.

"The most nutritious grasses are not the annuals, which live only just long enough to produce seed and then die, but the perennial ones, which store up in their stems and running rootstocks quantities of starch and gums and sugars, to be used by the plant when growth commences, at the end of the winter, or dormant, period. The perennial grasses are the ones that furnish the "natural hay" or winter forage. On those prairie pastures which are not overstocked a large percentage of all the grasses produce seed, a condition necessary if the continued existence of any species is to be maintained. But where there are too many cattle on the range, the flowering stems of the grasses are eaten off just as soon as they appear, and the grass is often "eaten into the ground." It is with these wild grasses just as it is with the tame ones. If the perennial species are not allowed to reseed themselves, if every leaf is eaten off just as soon as it peeps from the sod, the plants cannot survive. A turf grass like Kentucky blue grass will stand such treatment, but the grasses of the plains

Digitized by Google

and arid prairies are not turf formers. They are for the most part "bunch grasses," and cannot quickly adapt themselves to the changed conditions which require them to spread by sending out creeping runners beneath the sod. Their numbers have always been kept up by free seeding.

"Clearly, then, if the grazing quality of the ranges is to be improved, they must be so treated that the nutritious native species of grasses and forage plants can spread by means of the ripened seed. This can be accomplished by dividing the range up into separate pastures and grazing the different fields in rotation. There is a constant succession of species that ripen their seed from June until October, commencing with *Kœleria*, *Eatonia*, *Stipa*, and *Buchloe* in June and July, and ending with *Andropogon*, *Sporobolus*, and *Triodia* in October. If these grasses are killed out, their places will be taken by annuals of weedy proclivities, such as the numerous species of *Eragrostis* and *Aristida*, which are neither lasting nor nutritious; grasses that spring up with the early summer rains, ripen an abundance of seed, and die.

"Another result of overstocking the ranges is the injury that comes from the trampling and packing of the soil through the cattle having to travel long distances to water. In the grazing regions of Australia, which are for the most part as dry or dryer than our ranges, the squatters (ranchmen) depend upon surface water the year round. Each separate pasture or paddock has its artificial pond or "tank," constructed where it will catch the surface flow in the wet season. Such artificial ponds scattered over the ranges would obviate the trouble that comes from cattle having to travel long distances for water. It would be well if this system were more widely adopted in our own country.

"*Grasses and Cattle.*

"The success or failure of the cattle industry all through the prairie states depends upon the question of a sufficient supply of grasses and forage plants. In those sections of the country in which land is in the highest state of cultivation and the soiling method of feeding cattle is employed, three acres of ground will support five head of cattle per annum. This is at the rate of 1,066 cattle to the square mile.

"If the 300,000,000 acres of arable land in the Mississippi valley were to be devoted to such an intensive system of agriculture, and the productiveness of the land were equal throughout all the prairie states, more cattle could be raised each year than are consumed in the whole world. This grand total will give an idea of the possibilities of the land if the best crops are raised and the best agricultural methods are employed.

"Such an enormous production of forage and stock would not be warranted. The feeding of cattle for the domestic or foreign market is no more a golden road to wealth than is the cultivation of corn or wheat or cotton. The market can be glutted even with cattle and meat products. The supply must be kept within the limits of demand. We do not recommend that every farmer shall abandon wheat, corn, and cotton to devote his whole farm to the production of grasses and forage plants and of

Digitized by Google

the stock to eat them, but we do recommend that every prairie farmer shall cultivate at least ten acres of grasses and clovers."

Late in the year 1897 the following paper was prepared by Thomas A. Williams,* Assistant Agrostrologist of the United States Department of Agriculture, and issued by the department as Circular No. 4. It is of so much interest to Nebraskans that I deem it wise to reprint it.

III. THE RENEWING OF WORN-OUT NATIVE PRAIRIE PASTURES.

"Throughout the prairie regions of the West one frequently sees native pastures nearly devoid of grass and often grown up to weeds of various kinds. Plainly such pastures are of little value to the owners, so far as the forage obtained from them is concerned, and the weeds are a constant eyesore, often rendering the land even worse than worthless.

"Such a condition of things is usually due to two causes, drought and overstocking. While the farmer may have no control over the drought itself, he can, by a little care and foresight, put the pasture in condition to withstand it in a great measure, and he certainly can prevent the pasture from being overstocked. Not infrequently the use of the pasture is almost entirely lost for one or two seasons, when a little rest by removing the stock for a time or by feeding green corn, sorghum, or other soiling crops would have kept it in good condition.

"The native grasses are hardy and are adapted to the natural conditions which prevail on the prairies. Some species stand grazing much better than others, and after a pasture has been used for several years it will be found that the weaker grasses are giving way to the stronger ones.

"As a rule the forage obtained from the average prairie pasture is furnished by a comparatively small number of species. In the more thickly settled portions of the great prairie states, big blue-stem, bushy blue-stem, the wheat-grasses, switch grasses, prairie June-grass, wild-rye, blue-joint, and the various species of *Stipa*, *Poa*, and *Bouteloua* furnish most of the native pasturage.

"*Weeds of the Native Pastures.*

"The most troublesome weeds are either annuals or perennials. The former, because of their vigorous and rapid growth, spring up and take possession of a pasture in a very short time. The latter spread more slowly, but are more difficult to eradicate. Left to themselves, the native grasses will hold their own against the weeds, but when they are pastured off and trampled upon by the stock they are less able to cope with the more aggressive species, and soon begin to die out. This is the time when the farmer should give the grasses some extra care. With very little trouble the pasture can be kept in condition for profitable grazing, while neglect or carelessness may result in the practical loss of the use of the pasture for one or more seasons.

* It may be of interest to the readers of this report to know that Mr. Smith and Mr. Williams are graduates of the University of Nebraska, and that their earlier studies of grasses and forage plants were carried on in the botanical department of this institution.

Digitized by Google

"Perennial weeds, such as golden-rod, iron-weed, and some of the sunflowers, can usually be kept in check by mowing when in early bloom. The mower should be run high so as to miss as much of the grass as possible. Occasionally it is necessary to grub out such plants as the rosinweed.

"Annual weeds, like the mare's-tail or fireweed, sunflower, and ragweed may be destroyed in the same manner. The mowing should always be done before the seeds ripen. This not only gets rid of the weeds, but gives the grass a chance to take advantage of the fall rains. A thorough harrowing in the spring while the weeds are very young will destroy many of them and will also give new life to the grass. Very often weeds of both classes may be very effectually checked by burning over the pasture after they are well started in the spring.

"*Effect of Cultivation on Native Grasses.*

"The various native grasses are very differently affected by cultivation. Some do not do well at all and soon die out, others are but little affected either way, while still others respond very quickly and improve almost at once. This last class includes the most valuable of the native species, such as big blue-stem, western wheat-grass, wild-rye, and prairie June-grass.

"The effect of loosening up the soil is very apparent in the field which has "gone back" and seeded itself to wheat-grass or blue-stem. In many parts of Nebraska and the Dakotas three or more tons of hay are often cut from such fields. The fine growth which most grasses make along the edges of cultivated fields is a sight familiar to all who have traveled over the western prairies, and ought to be an object lesson to those to whom these same grasses are of so much importance.

"The fact that cultivation improves the more desirable native grasses has been demonstrated by nearly every experiment station in the West and by a great many private parties as well.

"An experiment made at the Kansas station in 1892 shows what a thorough stirring up of the soil will do for an upland prairie pasture. The experiment was made on a pasture in which the grasses had been dying out for some time and the weeds were beginning to appear in abundance. It had been reduced to this condition by drought and overpasturing. The surface was thoroughly loosened up by driving a weighted disc harrow over the field in several directions. The pasture was sown to a mixture of orchard grass, meadow fescue, blue grass, timothy, red top, clover, and alfalfa, which was harrowed in and a roller was driven over the field to level the surface and firm the ground. The seed germinated quickly and the tame grasses made an excellent start, but by September the wild grasses had crowded them out and had complete possession of the field.

"In this case the stirring of the soil and the season's rest not only enabled the prairie grasses to recover and to overcome the weeds, but to crowd out a good stand of tame grasses as well.

Digitized by Google

"This has been the experience in Nebraska and South Dakota, where like attempts have been made to renew worn-out pastures. The tame grasses are undoubtedly valuable aids, since the hardier of them will retain at least partial possession of portions of the pasture and add considerably to the forage obtained. Many of them, though they do not as a rule stand drought so well as the native species, start earlier in the spring or make a better growth in the fall, and thus lengthen the season during which the pasture may be used.

"The continual trampling of the stock cannot help but pack the soil more or less, and consequently prevent its proper aeration. This packed condition also keeps the water from gaining ready entrance, and it runs off and is lost. This, too, when lack of moisture is perhaps the principal reason for the failure of the pasturage. The old grass roots become crowded and die out or are weakened through lack of available food and suitable soil in which to develop.

"It is very readily seen why the treatment which was given to the pasture at the Kansas station produced such excellent results. The tearing up of the soil gave ready access to air and moisture, putting new life into the roots of the grasses, which were cut up and separated by the disk harrow, so that thousands of new shoots sprang up immediately. The rest for one season gave these new plants time to get well established and form a new sod.

"If this treatment is given before the pasture is too badly damaged, there is usually no need of sowing so much tame grass seed. There is little doubt that an occasional tearing up of this kind and a little care given to the time and manner of pasturing will get as much pasturage from the native grasses as can be obtained from tame varieties under the same conditions.

"*Manuring Native Pastures.*

"There is quite a diversity of opinion among farmers and stock raisers on the question of manuring native pasture lands. Some have obtained excellent results by manuring, while others seem to have had quite the opposite experience.

"The soil of the western prairies is very rich, and under ordinary circumstances will give fair returns without the application of fertilizers of any kind. Nevertheless, it is certain that better returns may be had if more *available* food is placed within reach of the grasses. Anyone who has observed a piece of grass land so situated as to receive the wash from a barnyard, will have found that near the yard where the supply of fertilizer has been great the grasses have becomed thinned out to a few species, while where the supply has been moderate the grasses are much more evenly developed and the yield decidedly better than upon the unfertilized prairie. The lesson is plain. A too plenteous application of fertilizer will thin out the grasses and reduce the yield of forage at least for the first season or two, since many species will not stand such treatment. On the other hand, a proper amount of fertilizer will increase the yield. It is

Digitized by Google

quite possible to use too much fertilizer for any crop, and the native grasses seem to be more sensitive in this respect than the ordinary cultivated species.

"Any pasture which has been grazed closely for some time will be benefited by an application of a thin top dressing of well-rotted stable manure, followed by a thorough harrowing. It is doubtful if much is gained by putting coarse unrotted manure on the pasture; it can be used to better advantage on the cultivated land. Ashes usually have a beneficial effect upon grasses on soils not too plentifully supplied with alkali.

"*Sowing Tame Grasses on Native Pasture Lands.*

"While it is hardly possible, and not always desirable, to make a native pasture over into a tame one, yet, as stated before, the pasturage may be materially increased by the addition of some of the cultivated species. A pasture which has had the thin places seeded to hardy tame grasses is certainly more valuable than it would be were these same places grown up to weeds.

"In dry upland pastures such grasses as Kentucky blue grass, sheep's fescue, red fescue, and Canadian blue grass may be used to advantage. The fescues are especially valuable if the soil is very sandy. It is likely that smooth brome grass will prove useful on pastures that are to be kept for long periods of time.

"Lowland pastures, particularly those in which the grass has been killed out by overflowing, may be reseeded with timothy, fowl meadow grass, red top, meadow fescue, and alsike. Kentucky bluegrass will do well if the soil is not too wet.

"The practice of collecting the seeds of such native species as western wheat grass, slender wheat grass, wild rye, prairie June grass, and the blue stems, and sowing them on the pasture is to be recommended. The writer recalls an instance where a farmer in South Dakota obtained an excellent pasture by collecting western wheat grass and filling in the bare places with it. Where the wheat grasses are naturally abundant excellent results have been obtained by plowing up the pasture and keeping the stock off of it until these grasses take possession, which occurs in a very short time.

"Though timothy as a general thing is a poor pasture grass for upland soils, it may sometimes be profitably employed in old or worn pastures. The farmer very often has a greater or less quantity of seed which has shattered out in the haymow. It has cost practically nothing and would probably hardly pay for the cleaning if he were to sell it. If this be scattered about over the pasture, either in the fall or spring, it will pay very well, indeed. The timothy may not live in the pasture more than two or three years, but it will yield considerable forage in the meantime and help the native grasses keep down the weeds. In eastern Nebraska, Kentucky blue grass is one of the best grasses that can be used for reseeding the native pastures. The seed may be sown just as the last snow is melting in the early spring. The grass when once started keeps slowly spreading,

Digitized by Google

and after a time forms an excellent sod. It begins its growth early in the spring and, though often dry and short during the midsummer, makes good grazing after the fall rains, and hence gives a longer season, during which the stock can be kept on the pasture. Another plant which can be profitably used for this purpose is white clover; it persists in the soil for a long time and, though small, adds considerably, both in quantity and quality, to the pasture and exerts a beneficial influence upon the soil.

Summary.

"1. Keep from overstocking.

"2. When the soil begins to get baked and packed, stir it up with a harrow.

"3. Give occasional light top-dressings of well-rotted stable manure.

"4. Fill in thin spots with hardy tame or wild grasses before the weeds get a start.

"5. Keep the weeds mowed off so that the grasses may get the benefit of *all* the plant food there is in the soil."

IV. SELECTED POPULAR DESCRIPTIONS OF FORAGE PLANTS.

The following descriptions by Jared G. Smith are selected from Bulletin 2 of the Division of Agrostology, in the hope that through them the farmers of Nebraska may be induced to make careful trial of some of the unusual forage plants here suggested.

ATRIPLEX SEMIBACCATUM. Australian Saltbush; Saltbush.

A procumbent or prostrate much-branched slender perennial, with herbaceous stems spreading one to four feet in every direction. This species of Australian saltbush has become widely known within the last ten years, it being one of the best crops that can be grown for the reclamation of alkali land in California and the southwest. It is a native of the Darling and Lachlan River valleys in New South Wales. Experiments conducted by the California Experiment Station have warranted the conclusion that the growth of the plant is vastly better on alkali soils than on ordinary dry soils. The saltbush takes up from the soil, when it is grown where there is an excess of alkalies, enormous quantities of these deleterious salts, so that the ashes often amount to one-fifth of the total weight of dry forage. The amount of crude protein in saltbush is nearly as great as in alfalfa. It is an excellent forage plant for soiling sheep, though the nutritive ratio is such that it needs to be fed with hay or other coarse fodder in order to obtain the best results. Saltbush contains a bitter principle which acts as a tonic. It is probably the best plant for growing on alkali spots, especially if the crop is removed from the ground each year. Every ton of green forage so removed contains about 110 pounds of mineral ingredients, of which the soda salts form a very large percentage. Saltbush is not so well adapted to those portions of the west where the winters are severe, in such localities being an annual and requiring fresh seeding each season. The seed may be obtained at fair prices in the California markets.

CAREX RETRORSA. Late-fruited Sedge.

A stout, erect, tufted, leafy sedge, one and a half to three feet high,

Digitized by Google

growing in wet, boggy places in the lake region of Minnesota and the Dakotas. It is very tender and juicy, and is readily eaten by stock. It is seldom cut for hay, because of its growing in places too wet to be mowed, but it is an important factor in the natural forage of the region. Analyses show that it contains nearly sixteen per cent crude protein. This is one of the species which is deserving of cultivation.

CAREX VULPINOIDEA. Fox Sedge.

A perennial sedge, common throughout the prairie region of the West, with stiff, sharply three-angle stems, one to two and a half feet high, and flattish, long-pointed leaves, longer than the stems. It grows in large bunches, and prefers low prairies and rather dry swales. It is readily eaten by stock. Analyses show that hay of this species contains over ten per cent crude protein.

CYPERUS ESCULENTUS. Chufas; Hognut; Ground almond.

A perennial sedge, spreading extensively by underground stolons, which produce enormous numbers of edible tubers. In rich, sandy loams it is often cultivated as a food for hogs, which are turned into the field in autumn to root up the nuts. The tubers contain from 17 to 28 per cent of oil, 27 to 29 per cent of starch, and 12 to 21 per cent of gum and sugar. This sedge is important for cultivation in desert regions. The oil extracted from the nuts is said to surpass in excellence all other oils used for culinary purposes.

ELEOCHARIS PALUSTRIS. Common spike rush.

A spike rush with slender, cylindrical, upright tufted stems, 1 to 4 feet high, from perennial roots and running rootstocks. Very common in shallow water or in wet meadows from Lake Champlain along the Great Lakes to Minnesota and northward. The leafless stems yield a considerable amount of early pasturage in wet meadows. The hay contains 9½ per cent of crude protein.

EUROTIA LANATA. Winter fat; White sage; Sweet sage.

A perennial half-shrubby plant growing a foot or two high, abundant throughout the Rocky Mountain region from British Columbia to Mexico. Its slender woolly twigs bear narrow leaves an inch and a half long, with velvety grayish surfaces, and with the margins rolled back. The flowers are minute, in small clusters in the axils of the leaves, chiefly on the upper parts of the stem. In western Texas and in the more arid regions of Arizona, Nevada, and Utah this plant is very highly valued for winter forage. An important fact in regard to the plant is its ability to thrive in alkali soils. It contains a bitter principle, which is sometimes employed as a remedy for intermittent fevers. Sheep and cattle grazed on lands where Winter Fat grows increase in weight rapidly, and are said to be remarkably free from disease. It is worthy of trial, and should be introduced into the pastures of all arid and semi-arid or alkaline grazing regions.

HELIANTHUS TUBEROSUS. Artichoke.

The artichoke is a native of North and South America, and has been cultivated in this country for fifty years or more for its edible tubers. Fed

Digitized by Google

to milch cows, these tubers, which contain large amounts of sugar and gum, increase the flow of milk enormously. The leaves are also eaten by all kinds of stock. Artichokes are planted like potatoes, but greater distances apart, and the yield is from 200 to 500 bushels per acre. On rich and friable soils it yields spontaneously and uninterruptedly for several years without replanting. The tubers should be dug in autumn after the upper part of the plant has been killed by frosts, as at that time they contain the most sugar. It grows best in loams containing a high percentage of potash.

HOSACKIA PURSHIANA (*Lotus americanus*). Wild vetch.

An annual vetch widely distributed from Minnesota to Arkansas and west to the Pacific, in fields and open prairies. The erect branching stems are 6 to 18 inches high, the trifoliate leaves nearly sessile, smooth to silky haired, the flowers small, solitary, and inconspicuous, the pods narrow, flattened, six-seeded, and about an inch long. It is very common in the prairie region, especially along the Upper Missouri, and in some parts of California. It blooms all summer, and being readily eaten by all kinds of stock is, on this account, a valuable plant on the ranges, withstanding close pasturing and trampling, and reseeding itself freely, no matter how closely it may be eaten down. Cattle and sheep become "rolling fat" on pastures where this vetch abounds. It is one of the most promising native forage plants, and should be given an extended trial in cultivation, being particularly adapted to the drier soils.

MEDICAGO SATIVA. Alfalfa; Lucern; French lucern; French clover, in part; Lucern clover; Lucern medicago; Alfalfa clover; Chilean clover; Brazilian clover; Spanish trefoil; Purple medick; Manured medick; Cultivated medicago; Medick.

Alfalfa is one of the best known and most extensively grown forage plants throughout the entire United States, with the exception of New England. It is the best hay and soiling crop in the West, and is being rapidly introduced into the southern and eastern states. It is an upright, branching, smooth perennial, one to three feet high, with three-parted leaves, each leaflet being broadest above the middle. The purple pea-like flowers, instead of being in a head, as in red clover, are in long, loose clusters or racemes, scattered over the entire plant. The ripe pods are spirally twisted, and each contains several seeds. Alfalfa is a deep feeder. The taproot descends to a great depth wherever the soil is loose and permeable, often averaging ten to fifteen feet, while extraordinary depths of fifty or sixty feet have been recorded. It will grow in favorable soil anywhere from sea level up to 7,000 feet elevation, and the success or failure of the crop depends as much upon the character of the subsoil as upon the surface layers. Good drainage is necessary, as the plants are killed by excess of water in the soil or on the surface. Water must never be allowed to stand on a field for more than forty-eight hours at a time. It feeds most heavily on lime, potash, magnesium, and phosphoric acid, yielding better and uniformly heavier crops on the rich prairies west of the Missouri river, which contain a greater percentage of these mineral in-

Digitized by Google

gredients than the older cultivated lands of the East. If the subsoil is heavy and stiff and impervious to water, alfalfa will never be a permanent success, no matter how well the surface soil may be prepared. Thorough preparation of the seed bed is the first essential. Plow deeply and subsoil deeply, and before planting the seed, work the field until it is in perfect tilth. Seed should be sown broadcast in amounts of from fifteen to twenty-five pounds per acre, according as to whether a seed crop or a hay crop is desired, as soon as the ground is warm and there is no further danger from frost. Cover the seed very lightly. If sown broadcast, a light harrow or brush would be sufficient; or, if there is rain immediately after sowing, no harrowing will be necessary. The field selected should be free from weeds, and the alfalfa should be sown without any nurse crop, as the young plants are very tender, and are easily choked out by a nurse crop or a rank growth of weeds. A crop may be cut as soon as it has attained the height of twelve to fifteen inches. The second and following crops should be cut when the plant is coming into bloom, as at that period it contains the highest amount of digestible food. A heavier yield may be obtained by waiting, as many do, until the pods commence to form, but the stalks are then woody and less palatable, and there will be more waste in feeding than if it had been cut when in early bloom. Considerable care is necessary in curing, to prevent heating, and especially to prevent the loss of leaves. The best practice is to cure in haycocks. Stacks of alfalfa will not turn water unless they are topped off with marsh or prairie hay, or covered with hay caps. The feeding value of alfalfa is very high, provided the crop is cut in due season; at the time of the first flowering, the crude protein amounts to about 18 per cent, and decreases to 10 or 11 per cent about the time ripe seed is formed. To be used economically, alfalfa hay should be fed with prairie or timothy hay, millet, corn fodder, or some other forage rich in carbohydrates. When cut in time, and properly cured, alfalfa hay is an exceedingly valuable item in the farm economy. Wherever the soil and climate are adapted to it, a field of alfalfa should be on every man's farm.

MELILOTUS ALBA. Sweet clover; Bokhara clover; Large white clover; Tree clover; Cabul clover.

This is a weedy biennial, concerning which extravagant claims have been made. It is chiefly valuable in the southern states for early pasturage and for green manure. The long tap roots descend deeply into the soil, and when the crop is turned under, a very large amount of available plant food is left for the benefit of succeeding crops. Because of its strong odor, stock will not eat it until they have acquired the taste, but if they are turned into a field of sweet clover in early spring, before the other clovers have commenced to come up, they will quickly learn to eat it. The seed should be sown alone in August, or in February, at the rate of half a bushel to the acre. If sown in the spring, a crop may be cut in autumn, and two or three crops the second season. It must never be allowed to go to seed.

Digitized by Google

MELILOTUS OFFICINALIS. Yellow sweet clover; King's clover; Hart's clover; Plaster clover; Melilot clover; Common melilot; Wild laburnum.

This European species has become quite widely naturalized in this country. It possesses little value—not enough to warrant its cultivation. It grows in swamps and in wet meadows, while *M. altissimus* grows only on the driest soils.

PISUM ARVENSE. Gray winter pea; Canada field pea; Field pea.

The common field pea is a native of Italy, and has been in cultivation for a good many hundred years. It is grown chiefly for its seeds, which are used both as an article of diet and for fattening cattle. It is one of the best soiling crops for milch cows, and is largely used in the Northern States and Canada, and as far west as the Dakotas, for this purpose, and for green manure. The seed is sown broadcast and harrowed in. It is planted in early spring, and is ready to cut in May or June. For soiling the fodder is sweet, palatable, and very nutritious. It also makes an excellent quality of ensilage. It grows best on light calcareous loams and produces heavy crops on rich land.

POLYGONUM AVICULARE. Knotweed; Duckweed; Dooryard grass.

A weedy annual of the knotweed or smartweed family, common everywhere in door-yards, waste places, and fields. The stems are slender, prostrate or ascending, branching, six to fourteen inches high, and leafy; the leaves oblong to lanceolate, from one-fourth of an inch to an inch long, pointed at each end, and bluish green. It is very hardy, growing readily on the poorest of ordinary soils, even in times of drought, and is greedily eaten by all kinds of stock. Stockmen in the Northwest esteem it highly, as it furnishes a palatable and nutritious forage, which continues green all summer under all kinds of hard treatment. The dry forage contains nearly nineteen per cent of crude protein, so that its value as a flesh former is high, ranking above that of the clovers.

TRIFOLIUM HYBRIDUM. Alsike clover; Alsace clover; Hybrid clover; Bastard clover; Swedish clover; White Swedish clover; Giant White clover; Perennial hybrid clover; Elegant clover; Pod clover.

A perennial, in size and general appearance intermediate between white and red clover. It is better adapted than any other species in general cultivation to wet meadows or marshy lands, but because of its shallow root system will not withstand drought. The branching, leafy stems grow one to three feet high, and the young flower heads are at first white and later become rose-colored. Its leaves are slightly bitter, and on this account the forage is not so well liked by stock as that of red or white clover; but it will grow on lands which are too wet for the other species, thriving even in marshy places where the sub-soil is impervious to water and the drainage is bad. It may also be cultivated in the far North and in high altitudes, as it has the power of withstanding severe cold. The forage is succulent and more difficult to cure for hay than red clover. The air-dried hay contains from 10 to 13 per cent of crude protein. It is a very good honey plant for bees. The seed weighs sixty-five pounds to the bushel, and twelve pounds will sow an acre.

Digitized by Google

TRIFOLIUM INCARNATUM. Crimson clover; Scarlet clover; German clover; German mammoth clover; Italian clover; French clover, in part; Egyptian clover, in part; Carnation clover.

An annual, native of the Mediterranean region, which has been long cultivated in the warmer portions of Europe, and is now grown in many of the eastern and southern states for an early soiling crop. The stems are erect, tufted, soft-hairy all over, from one to two feet high, and the bright scarlet flowers are borne in elongated heads. In Virginia and southward it should be sown in autumn to furnish winter and early spring forage. It is susceptible to drought. It is not suited to the northern and northwestern states, as it suffers severely from excessive cold. Twenty pounds of seed should be sown per acre. Hay made of Crimson clover contains about 13 per cent of crude protein. To make the best hay, it must be cut when in full bloom; cut later, there is some danger in feeding it, especially to horses, on account of the bristly hairy bracts of the inflorescence, which form hair balls in the stomach. A number of such cases, resulting in considerable loss, have been reported during the past seasons.

TRIFOLIUM MEDIUM. Cow grass; Cow clover; Large American clover; Mammoth clover; Large clover; Fall clover; Saplin or sapling clover; Pea-vine clover; Meadow clover; Sand clover; Zigzag clover; Clover trefoil; Medium clover; Early clover; Wavy-stemmed clover; Zigzag hare clover; Red perennial meadow clover; Soiling clover; Perennial red clover.

A rank-growing perennial with zigzag stems, oblong, entire, spotless leaflets, and stalked heads of purple flowers. It is better adapted to wet meadows or marshy lands than is the ordinary clover, and in such places makes a very rank and rapid growth. It has about the same feeding value as red clover, and is well adapted to soiling purposes. Ten pounds of seed should be sown per acre.

TRIFOLIUM PRATENSE. Red clover; June clover; Early clover; Small red clover; Red top clover; Medium red clover.

A biennial or short-lived perennial clover, native of the Old World, but now extensively cultivated in both hemispheres. It is ascending, more or less branching, one to two feet high, with trifoliate leaves on long leafstalks and oval or blunt leaflets half an inch to an inch and a half long, with a large pale spot on the upper side, and pink flowers in large, rounded, stemless heads. Red clover holds the same position as a forage plant in the eastern and northern states as alfalfa in the Southwest and West, or as cowpeas in the South. Its cultivation is almost universal. The seed is sown at the rate of from fifteen to twenty pounds per acre, from March to May, either alone, or more commonly with grain. It requires a deep, rich, fertile, calcareous loam, neither too wet nor too dry. On the black-waxy and gumbo soils of the Mississippi valley, red clover is almost sure to freeze out or "heave" in winter, and on rocky or light, sandy soil it suffers from drought in summer. It is mown for hay twice in the season, the yield varying from three-fourths of a ton to two tons at each cutting. The hay contains from 12 to 16 per cent of crude protein, varying according to the fertility of the soil. The yield of seed ranges from

Digitized by Google

three to nine bushels, of sixty pounds each, per acre. It is one of the best money crops of the eastern farmer, and is an excellent one for pasturage, soiling, hay, or to turn under for green manure.

TRIFOLIUM REFLEXUM. Buffalo clover; Pennsylvania clover.

A native annual or biennial species with ascending downy stems, oblong, finely toothed leaflets, and rose-red flowers on short stalks in a round, stalked cluster. The flowers are reflexed and brownish in fruit. Widely disseminated from western New York to Nebraska, Kansas, and southward, and especially abundant in the middle prairie region, where it furnishes a considerable amount of palatable and highly nutritious forage, greedily eaten by all kinds of stock. It is a species which should be brought into cultivation.

TRIFOLIUM REPENS. White clover; White Dutch clover; Dutch clover; Creeping trifolium; White trefoil; Stone clover, in part; Honeysuckle; Honeysuckle grass; Honeysuckle clover; Shamrock.

A smooth perennial, growing wild in New England and Europe, and now widely cultivated. The slender spreading and creeping stems are from four to eight or ten inches long; the trifoliate leaves are on rather long leafstalks; the flowers are white or rose-color, borne in loose heads an inch or less in diameter, on very long stalks. It grows on a great variety of soils, forming excellent turf either for pastures or lawns, and thrives under all sorts of hard usage. If sown alone, from six to eight pounds of seed should be used, but it is usually mixed with the seed of grasses or other clovers. The forage, though produced in small quantities, is sweet and nutritious, and eagerly sought for by all kinds of stock.

VICIA VILLOSA. Hairy vetch; Sand vetch; Russian vetch.

An annual, native of western Asia, which has been cultivated for about fifty years. Hairy vetch is an excellent soiling crop, one of the best that has been introduced into the United States, although, on account of the high price of the seed and the large amount which must be sown per acre, it has not been widely cultivated. The seed should be sown at the rate of a bushel and a half per acre, from the latter part of April to the middle of May for summer forage, or from the middle of August to the middle of September for winter forage. The nutritive value of the hay is very high, analysis by Coudon in 1890 showing 23 per cent of crude protein. The yield varies from one and a half to four tons per acre, according to the fertility of the soil. It has been grown successfully in all parts of the country and has proved to be hardy in the moist costal regions of Washington, the dry prairies of South Dakota, and the rich loamy soils along the gulf. It is deserving of wider cultivation in all parts of the United States.

VIGNA CATJANG. Cowpea; Southern cowpea; Pea; Field pea; Stick pea; Cherry bean; Chinese vetch.

A leguminous annual of unknown origin, which has been cultivated in oriental countries for many centuries, both as a forage plant and for the seeds as an article of human diet. It is especially adapted to warm coun-

Digitized by Google

tries and is extensively cultivated throughout the South, having been introduced there about the middle of last century. There are many named forms or cultural varieties, all of which, however, are considered by botanists to be derived from one species. It so readily adapts itself to different soils and changes its character so readily under cultivation that there has been much difficulty in determining the limits of the various named forms. The cowpeas are of three general classes, according to their habit of growth, consisting of "bunch" varieties, which grow erect and compact; "runners," which start off erect and then throw out running branches, and "trailers," which grow flat upon the ground with long stems sometimes fifteen or twenty feet in length. There is also much variation in size, shape, and color markings of the seeds, and in the manner in which the seeds are borne in the pod, the seeds of some being closely crowded together, called "crowders," and others with the seeds wide apart and the pod constricted between each seed, called "kidney" peas. The bunch varieties are the ones which are best adapted to growing for hay and ensilage, while the runners and trailers are valuable for soiling purposes or for turning under as green manure. The length of season required for maturity also varies greatly, the bunch varieties, as a rule, requiring only a very short season. The feeding value of cowpeas, either green, fed as hay, or preserved as ensilage, is very high, being considerably above that of red clover. Cowpeas require a deep, rich, sandy loam, although, because of their strong root system, they are adapted to grow upon almost any soil which is not too wet. The ground should be well prepared, and the seed should not be sown until the soil is thoroughly warmed. Cowpeas, by means of the tubercles on the roots, gather large amounts of nitrogen from the air, and also pump up large amounts of valuable mineral fertilizers from the subsoil. When the stubble is plowed under after the crop has been removed, these valuable fertilizing elements —potash, nitrogen, and phosporic acid—are left in the surface soil for the use of succeeding crops. At the Rhode Island Experiment Station the total crop of green vines per acre was 35,000 pounds, containing 157 pounds of nitrogen, 109½ pounds of potash, and 32.2 pounds of phosphoric acid, and the additional quantity estimated to be contained in the roots was 17¾ pounds nitrogen, 10 pounds potash, and 5.15 pounds phosphoric acid. The percentages of fertilizers vary greatly, according to the fertility, and to some extent according to the variety grown. Experiments made at southern stations have unanimously proved that the best way to utilize fertilizers so produced by a crop of cowpeas is to cut the vines for hay, returning the manure to the fields. A common practice is to plow under a crop at the end of the season, or sometimes to permit it to remain on the ground through the winter, both of which methods result in a loss of a very large part of the value of a crop through leaching. The best method, if the crop is turned under, is to at once plant a winter forage crop to cover the surface of the ground and so prevent washing by the winter rains. The cultivation of cowpeas has extended to California. Some of the varieties having a short season may be grown in the prairie regions as

Digitized by Google

far north as Iowa and Nebraska, and are there of considerable value for dairying purposes, because of their resistance to drought, furnishing on rich soil a palatable and nutritious food during the hottest and driest summer months.

Digitized by Google

SEVENTH ANNUAL REPORT OF THE METEOROLOGIST.

By Goodwin D. Swezey, A.M., Meteorologist of the Board. In Co-operation with George A. Loveland, Section Director U. S. Weather Bureau.

Hon. Robert W. Furnas, Secretary of the Nebraska State Board of Agriculture:

Sir—I have the honor to transmit herewith my seventh annual report as Meteorologist of the Board, being substantially a statement of the meteorological conditions which have prevailed in the state during the year of 1897.

University of Nebraska,
Lincoln, March 1, 1898.

Digitized by Google

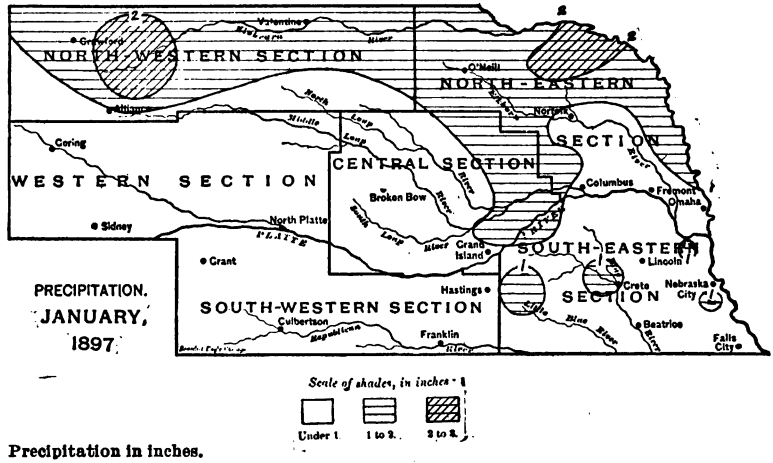
JANUARY.

The month was characterized by an unusual number of warm and cloudy days, with precipitation only in small areas.

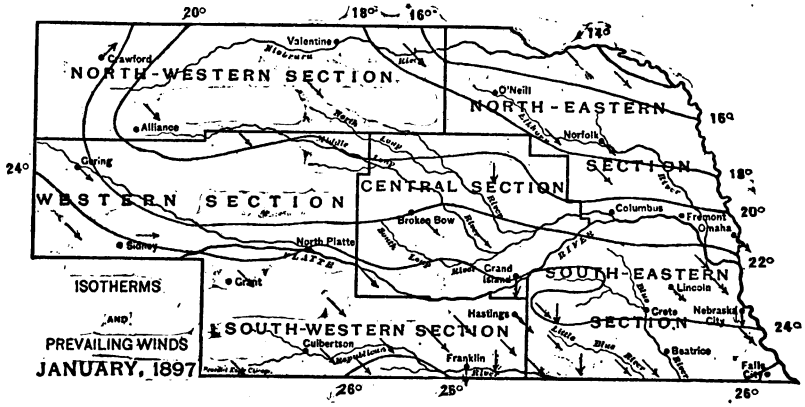
Temperature: The mean temperature for the state was 21.8 degrees, which is 3.0 degrees above the normal. The highest temperature reported was 66 degrees, and the lowest, —22 degrees.

Wind: The prevailing direction of the wind was from the northwest; the average velocity was 9.4 miles an hour, and the highest velocity in the state 46 miles an hour.

Precipitation: The average precipitation for the state was 0.79 inch, which is 0.11 inch above the normal. The largest rainfall reported was 2.50.



Precipitation in inches.



Dotted lines are drawn through points having the same mean temperature; arrows fly with the wind.

Digitized by Google

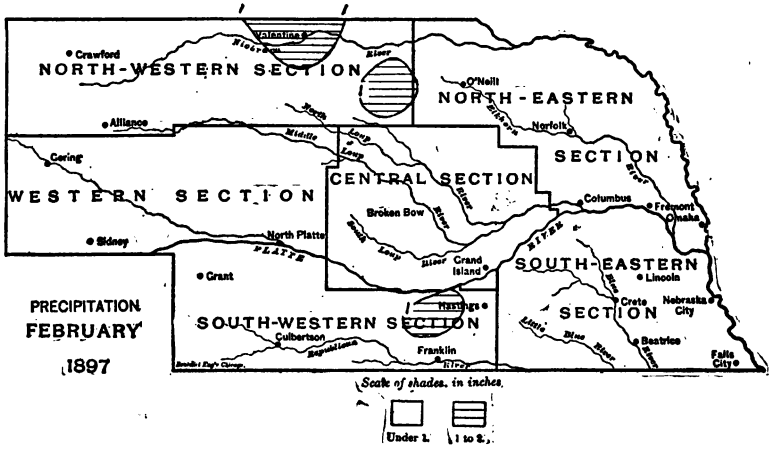
FEBRUARY.

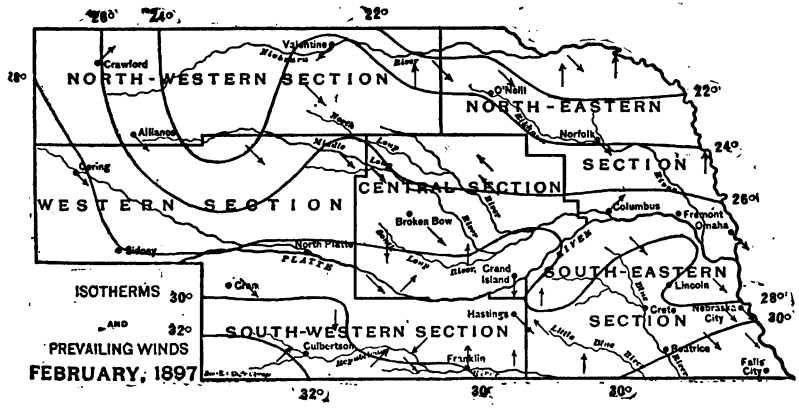
This month was characterized by an unusual number of cloudy days, and by normal snowfall and extremes of temperature.

Temperature: The mean temperature for the state was 27.2 degrees, which is 3.2 degrees above the normal. The highest temperature reported was 74 degrees, and the lowest, —20 degrees.

Wind: The prevailing direction of the wind was from the northwest; the average velocity was 7.6 miles an hour, and the highest velocity 38 miles an hour.

Precipitation: The average precipitation for the state was 0.59 of an inch, which is 0.12 of an inch above the normal. The largest rainfall reported was 1.94 inches.





Digitized by Google

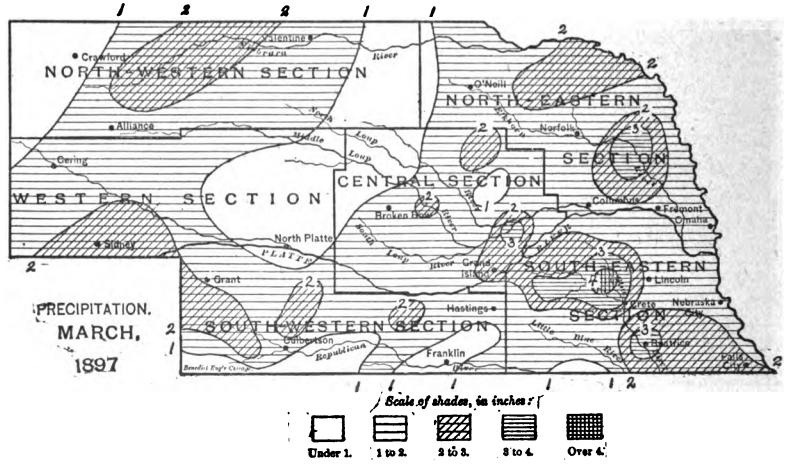
MARCH.

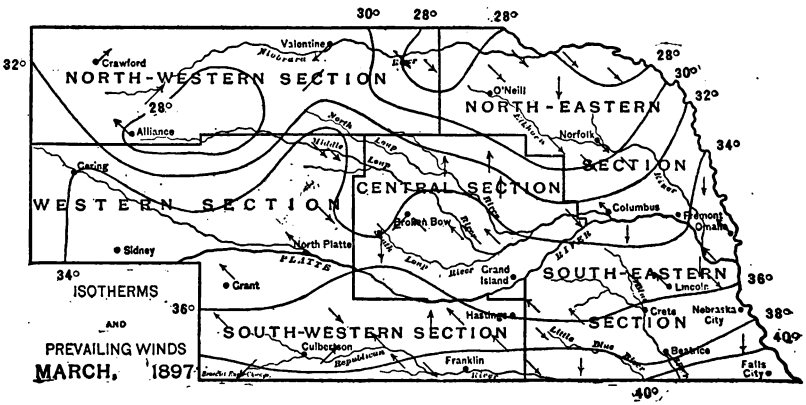
The month was characterized by normal temperature, an unusually large number of cloudy days, and an excessive amount of precipitation in the greater portion of the state.

Temperature: The mean temperature for the state was 34.2 degrees, which is 0.1 degree below the normal. The highest temperature reported was 82 degrees, and the lowest, —14 degrees.

Wind: The prevailing direction of the wind was from the northwest; the average velocity was 10.0 miles an hour, and the highest velocity 44 miles an hour.

Precipitation: The average precipitation for the state was 1.49 inches, which is 0.31 of an inch above the normal. The largest rainfall reported at any one station was 4.25 inches, and the least 0.26 of an inch.





Digitized by Google

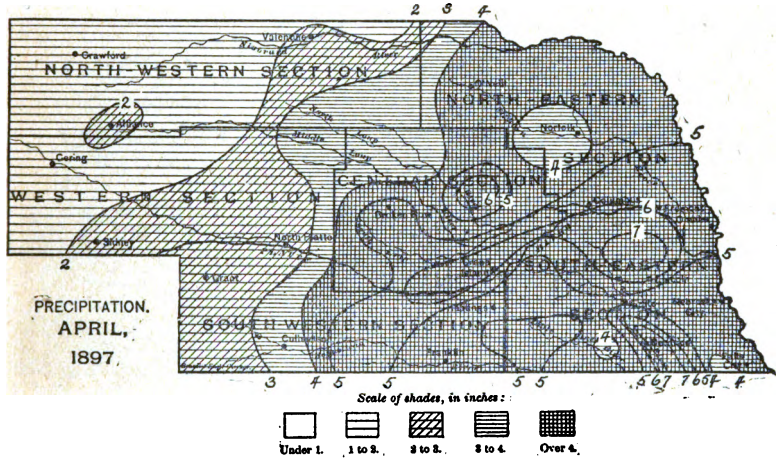
APRIL.

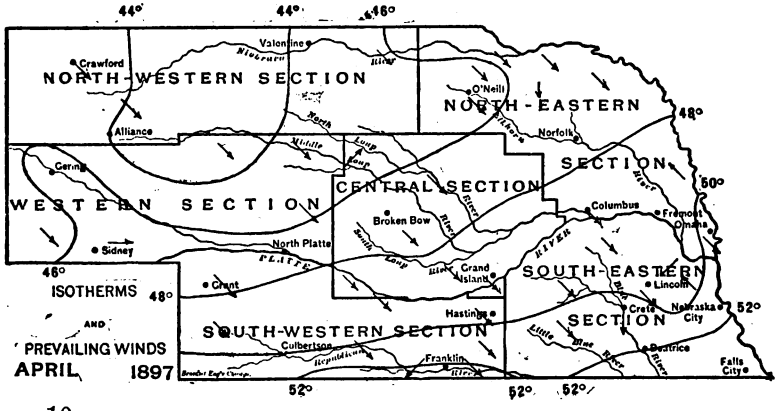
The month was characterized by low temperature, an unusually large number of cloudy days, and an excessive rainfall.

Temperature: The mean temperature for the state was 47.8 degrees, which is 2.2 degrees below the normal. The highest temperature reported from the state was 90 degrees, and the lowest, 8 degrees.

Wind: The prevailing direction of the wind was from the northwest; the average velocity was 11.0 miles an hour, and the highest velocity 50 miles an hour.

Precipitation: The average precipitation for the state was 3.82 inches, which is 1.41 inches above the normal. The largest rainfall reported was 8.72 inches, and the least, 0.40 of an inch.





Digitized by Google

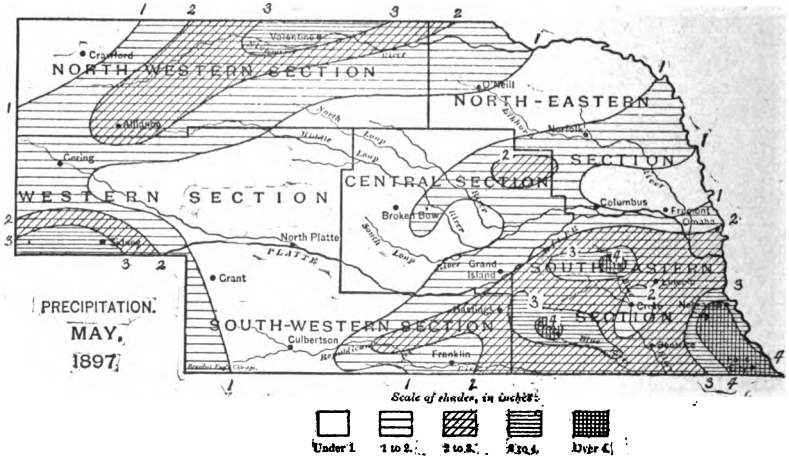
MAY.

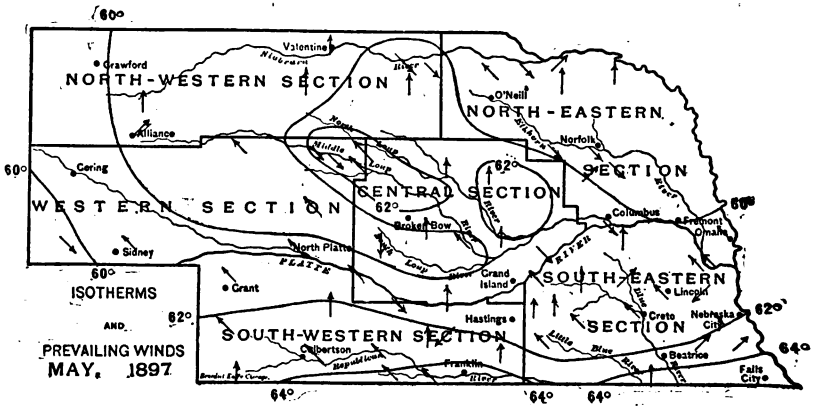
The month was characterized by a deficiency of rainfall, an absence of severe storms, and an unusually large number of frosts.

Temperature: The mean temperature for the state was 61.3 degrees, which is 2.2 degrees above the normal. The highest temperature reported from the state was 101 degrees, and the lowest, 19 degrees.

Wind: The prevailing direction of the wind was from the southeast; the average velocity was 8.7 miles an hour, and the highest velocity 46 miles an hour.

Precipitation: The average precipitation for the state was 1.66 inches, which is 1.95 inches below the normal. The largest rainfall reported was 7.09 inches, and the least, a trace.





Digitized by Google

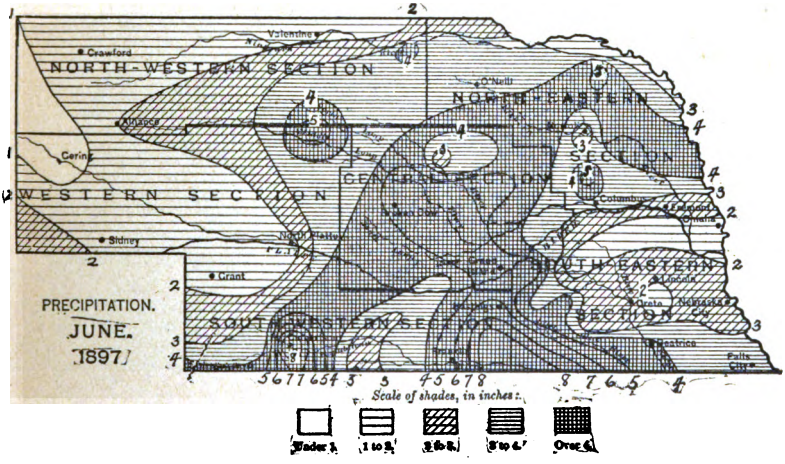
JUNE.

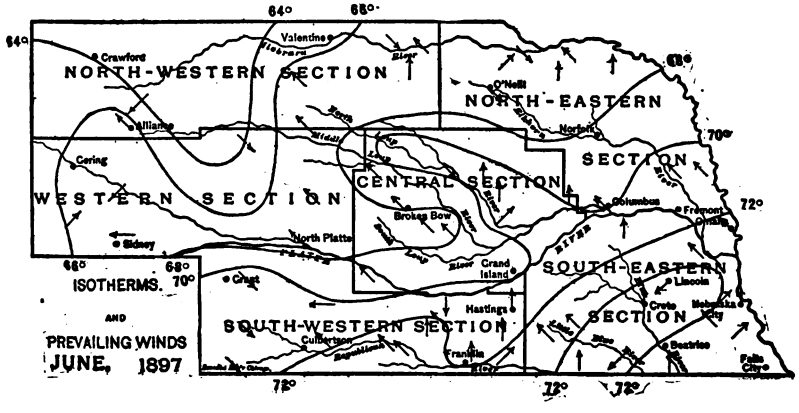
The month was characterized by normal temperature, a slight deficiency in rainfall, and an absence of severe storms.

Temperature: The mean temperature for the state was 69.5 degrees, which is 0.3 degrees above the normal. The highest temperature reported was 106 degrees, and the lowest, 35 degrees.

Wind: The prevailing direction of the wind was from the southeast; the average velocity was 9.2 miles an hour, and the highest velocity 55 miles an hour.

Precipitation: The average precipiation for the state was 3.60 inches, which is 0.32 of an inch below the normal. The largest rainfall reported was 12.25 inches, and the least, 0.67.





Digitized by Google

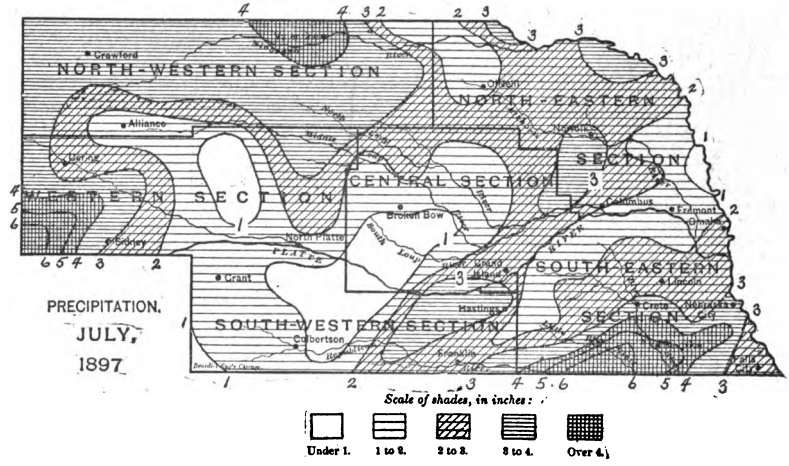
JULY.

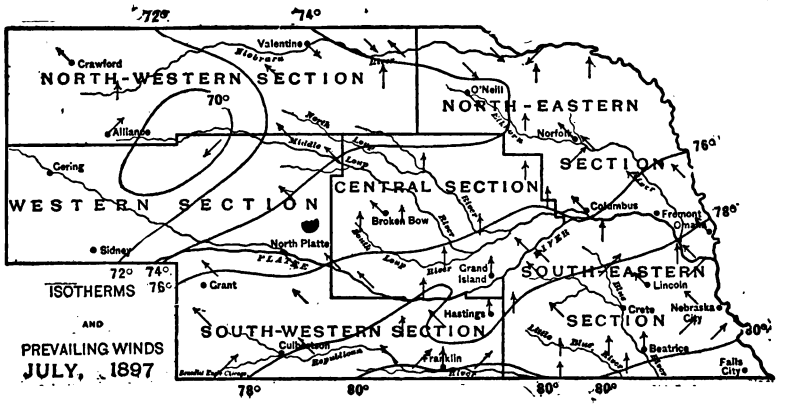
The month was slightly warmer than the normal, with a rainfall considerably below the average.

Temperature: The mean temperature for the state was 75.9 degrees, which is 0.6 degrees above the normal. The highest temperature reported was 112 degrees, and the least, 34 degrees.

Wind: The prevailing direction of the wind was from the southeast; the average velocity was 8.2 miles an hour, and the highest velocity 48 miles an hour.

Precipitation: The average precipitation for the state was 2.57 inches, which is 0.92 of an inch below the normal. The largest rainfall reported was 7.44 inches, and the least, 0.35.





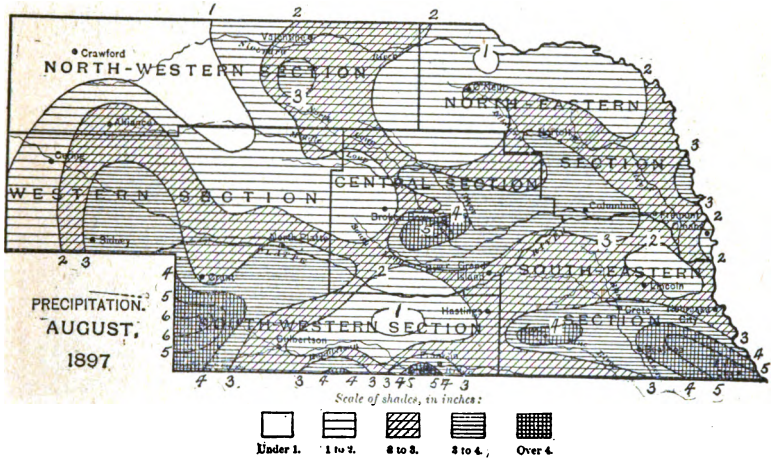
Digitized by Google

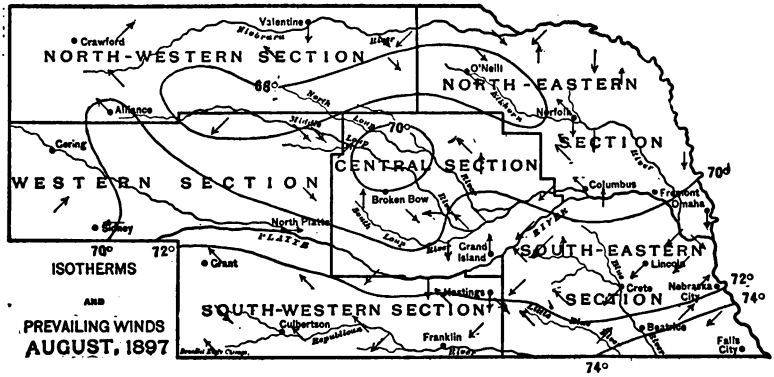
AUGUST.

Temperature: The mean temperature for the state was 70.8 degrees, which is 1.7 degrees below the normal. The highest temperature reported was 107 degrees, and the lowest, 37 degrees.

Wind: The prevailing direction of the wind was from the southeast; the average velocity was 7.6 miles an hour, and the highest velocity 48 miles an hour.

Precipitation: The average precipitation for the state was 2.60 inches, which is 0.02 of an inch below the normal. The largest rainfall reported was 7.75 inches, and the least, a trace.





Digitized by Google

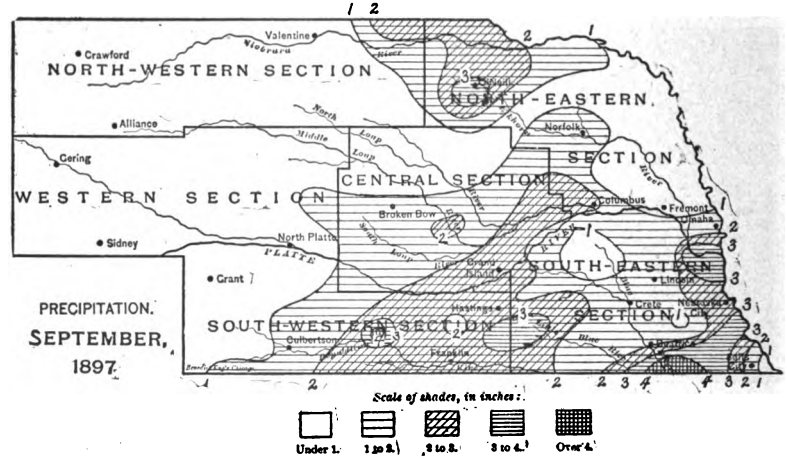
SEPTEMBER.

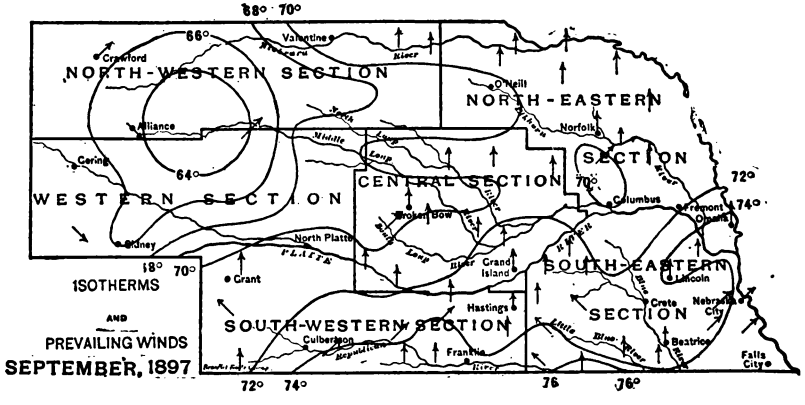
The absence of frosts and the unusually high temperature during the month caused all crops to fully mature without injury from freezing weather.

Temperature: The mean temperature for the state was 70.6 degrees, which is 7.0 degrees above the average for the past twenty-two Septembers. The highest temperature reported was 113 degrees, and the lowest, 29 degrees.

Wind: The prevailing direction of the wind was from the south; the average velocity was 8.6 miles an hour, and the highest velocity 41 miles an hour.

Precipitation: The average precipitation for the state was 1.26 inches, which is 0.58 inches below the normal. The largest rainfall reported was 4.88 inches, and the least, a trace.





Digitized by Google

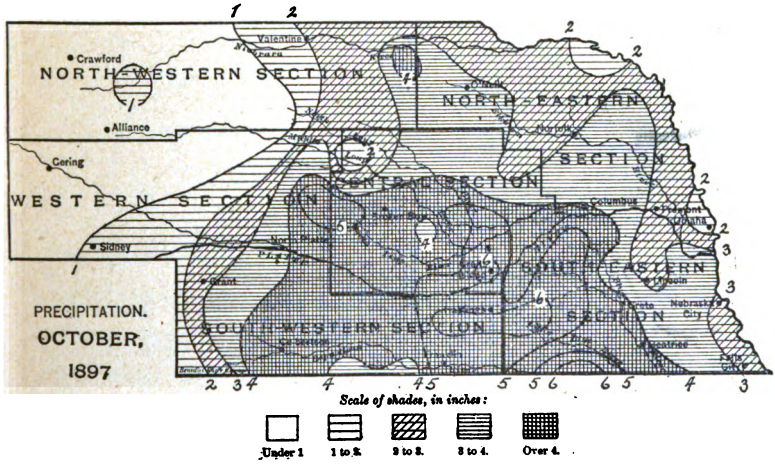
OCTOBER.

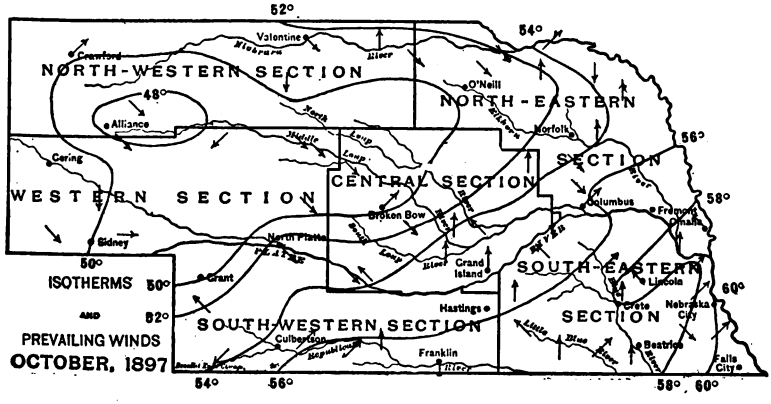
The month was characterized by high temperature, excessive precipitation, and a large number of cloudy and rainy days.

Temperature: The mean temperature for the state was 53.5 degrees, which is 8.3 degrees above the normal. The highest temperature reported was 98 degrees, and the lowest, 16 degrees.

Wind: The prevailing direction of the wind was from the south. The average velocity was 8.8 miles an hour, and the highest velocity 51 miles an hour.

Precipitation: The average precipitation for the state was 3.34 inches, which is 1.75 inches above the normal. The largest rainfall reported was 8.33 inches, and the least, a trace.





Digitized by Google

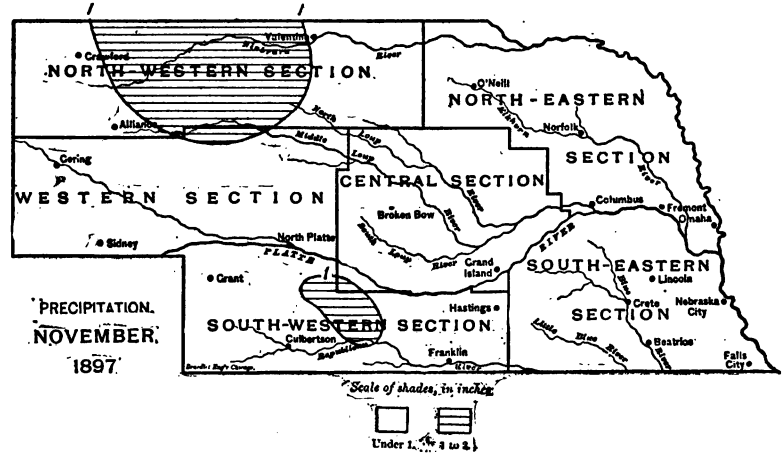
NOVEMBER.

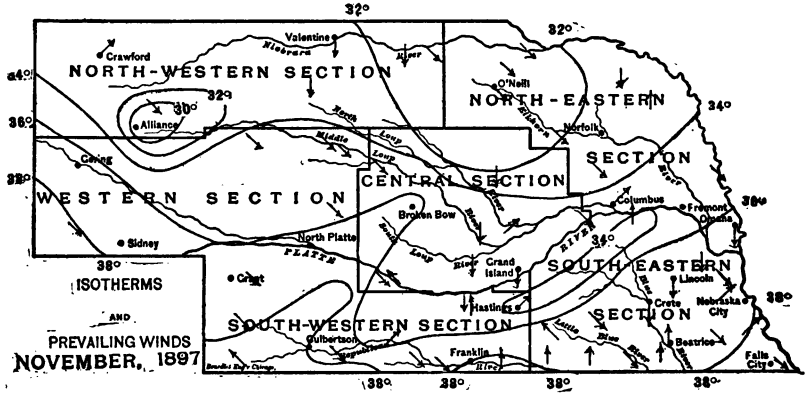
The month is best characterized as about a normal November, the temperature being slightly above and the precipitation slightly below the normal.

Temperature: The mean temperature for the state was 34.9 degrees, which is 0.4 degrees above the normal. The highest temperature reported was 84 degrees, and the lowest, 16 below zero.

Wind: The prevailing direction of the wind was from the northwest. The average velocity was 8.0 miles an hour, and the highest velocity 40 miles an hour.

Precipitation: The average precipitation for the state was 0.51 of an inch, which is 0.19 of an inch below the normal. The largest rainfall reported was 1.74 inches, and the least, a trace.





Digitized by Google

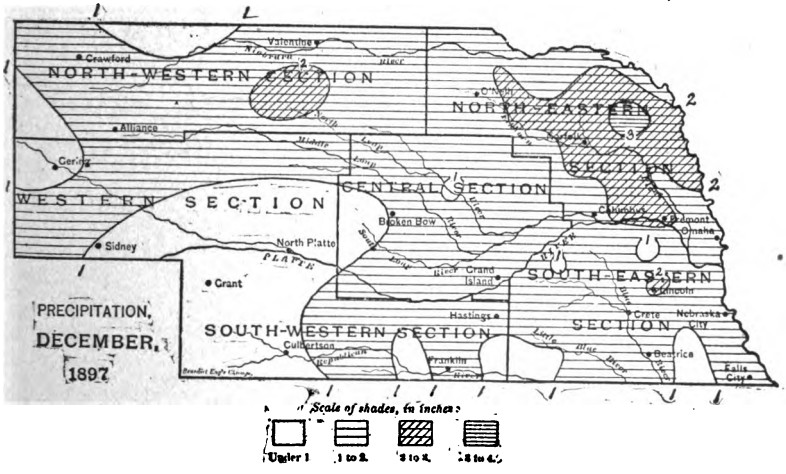
DECEMBER.

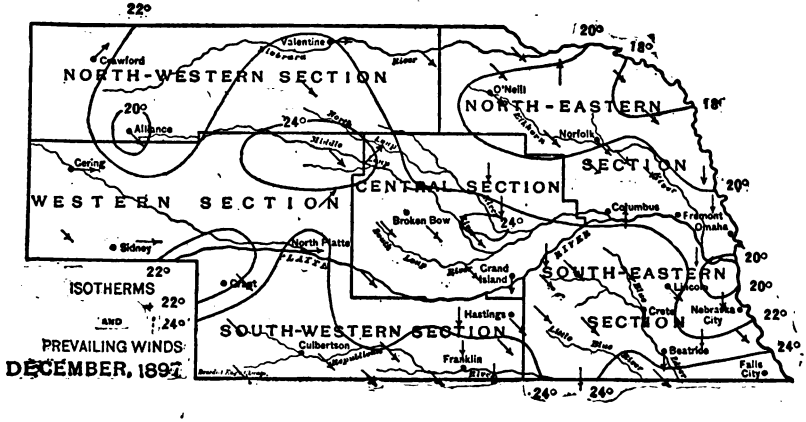
This month was characterized by low temperature and an excessive snowfall.

Temperature: The mean temperature for the state was 22.9 degrees, which is 2.9 degrees below the normal. The highest temperature reported was 68 degrees, and the lowest, 26 degrees below zero.

Wind: The prevailing direction of the wind was from the northwest. The average velocity was 8.2 miles an hour, and the highest velocity 40 miles an hour.

Precipitation: The average precipitation for the state was 1.31 inches, which is 0.61 of an inch above the normal. The largest rainfall reported was 3.10 inches, and the least, 0.10 of an inch.





Digitized by Google

FOR THE YEAR.

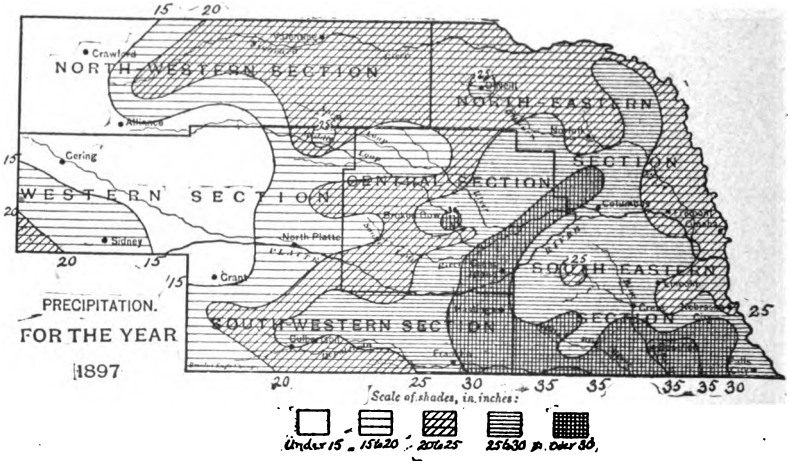
Temperature: The mean annual temperature for the state was 49.1 degrees, which is slightly above the normal. The mean temperature for January was 21.8 degrees, and for July 75.9 degrees. The lowest temperature was 26 degrees below zero, at Ashland, on the 18th of December, and the highest was 113 degrees, at Franklin, on the 7th of September.

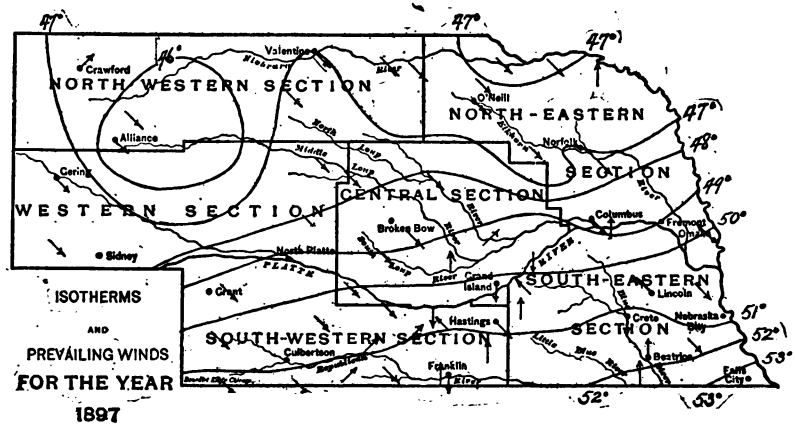
Wind: The average velocity of the wind was 8.7 miles an hour, and the maximum velocity 55 miles an hour, at Lincoln, on June 17.

Precipitation: The average total precipitation over the state for the year was 23.50 inches. The greatest was 38.72 inches, at Sutton, and the least was 10.49 inches, at Fort Robinson.

The total average snowfall was 36.5 inches. The greatest amount of snow reported was 72.2 inches, at Hay Springs, and the least was 16.5 inches, at Superior.

The average number of rainy days was 64, the maximum number being 118, at Valentine.





Digitized by Google

METEOROLOGICAL DATA.

Station.	Data.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Agee	Mean temperature	18.8	23.3	28.6	46.0	59.4	68.2	75.3	70.2	70.7	51.0	31.4	22.2	47.1
	Highest temperature	50	46	61	85	88	96	101	98	100	89	69	47	101
	Lowest temperature	-14	-10	-3	26	39	42	55	50	46	29	-6	-10	-14
	Precipitation	1.37	.8	1.34	4.08	2.31	3.94	1.74	.43	2.68	2.88	.22	2 15	24.30
	No. rainy days	7	7	6	9	5	8	6	3	4	7	3	7	72
	No. cloudless days	14	13	15	9	14	11	22	18	22	13	12	14	177
	No. partly cloudy days	7	7	5	9	13	13	6	10	6	12	5	4	97
	No. cloudy days	10	8	11	12	4	6	3	3	2	6	13	13	91
	Prevailing direction wind	N W	NW	NW	NW	SE	SW	NW	NW	S	NW	NW	NW	NW
Albion	Mean temperature	.....	.....	.....	.....	51.2	62.4	69.0	74.6	68.7	.....	53.6	33.6	21.4	.....
	Highest temperature	.....	.....	.....	.....	89	95	98	102	96	.....	88	77	51	.....
	Lowest temperature	.....	.....	.....	.....	26	29	35	49	44	38	27	-12	-13	.....
	Precipitation	.....	.....	.....	.....	4.63	2.69	4.74	2.56	2.30	1.82	2.82	0.58	1.58	.....
	No. rainy days	.....	.....	.....	.....	.....	6	14	6	8	4	8	2	7	.....
	No. cloudless days	.....	.....	.....	.....	16	17	19	26	26	26	16	.....	.....	.....
	No. partly cloudy days	.....	.....	.....	.....	.....	.....	6	4	1	3	8	.....	.....	.....
	No. cloudy days	.....	.....	.....	.....	14	2	5	1	4	1	7	.....	.....	.....
	Prevailing direction wind	.....	.....	.....	.....	.....	.....	.....	S	SE	S	S	NW	.....	.....
Alliance	Mean temperature	18.9	24.6	28.4	43.9	59.0	67.2	75.7	71.0	64.8	46 2	28.0	19.2	45.6	
	Highest temperature	52	42	61	78	84	92	100	94	92	85	70	48	100	
	Lowest temperature	-18	4	-4	19	37	40	56	56	40	24	-6	-16	-18	
	Precipitation	0.43	0.21	1.21	2.13	2,52	2.01	1.73	2.15	0.06	0.36	0.64	1.10	14.55	
	Rainy days	4	3	5	5	6	7	5	4	2	2	3	4	50	
	No. cloudless days	10	6	1	2	7	2	11	16	21	13	13	14	116	
	No. partly cloudy days	16	19	20	19	18	24	16	3	3	7	10	12	167	
	No. cloudy days	5	3	10	9	6	4	4	12	6	11	7	5	82	
	Prevailing direction wind	NW	NW	SE	W	SW	SE	SW	SE	NW	NW	NW	NW	NW	
Ansley	Mean temperature	22.6	27.4	34.2	47.2	62.2	67.1	74 0	67.9	72.2	51.1	34.4	23.2	48.6	
	Highest temperature	64	56	72	82	91	96	103	99	95	86	83	55	103	
	Lowest temperature	-15	-5	-5	22	23	37	48	41	35	25	-9	-9	-15	
	Precipitation	0.40	0.47	1.46	5.00	1.54	5.37	0.92	4.55	1.37	4.98	0.35	1.52	27.18	
	No. rainy days	3	7	6	7	5	12	6	9	6	5	2	4	72	
	No. cloudless days	14	9	14	9	23	12	24	16	23	18	15	16	193	
	No. partly cloudy days	5	14	10	10	6	12	5	9	5	7	10	6	99	
	No. cloudy days	12	5	7	11	2	6	2	6	2	6	5	9	73	

Digitized by Google

METEOROLOGICAL DATA—*Continued.*

Station.	Data.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Ansley	Prevailing direction wind	NW	NW	SE	NW	S	SE	S	NW	S	NW	NW	NW	NW
Arapahoe	Mean temperature	21.9	27.5	34.4	49.7	63.6	73.3	81.1	73.6	70.7	54.0	35.5	22.8	50.7
	Highest temperature	50	60	70	80	89	96	102	102	100	89	72	52	102
	Lowest temperature	-18	-2	4	30	40	46	60	52	45	30	-2	-15	-18
	Precipitation	0.40	0.70	0.86	5.69	2.50	2.90	1.48	1.35	4.88	4.96	1.17	1.02	27.91
	Rainy days	2	2	4	8	1	5	5	3	4	4	2	4	44
	No. cloudless days	15	9	16	12	9	12	28	22	26	20	12	6	187
	No. partly cloudy days	5	13	5	5	13	8	2	8	0	3	11	14	82
	No. cloudy days	11	6	10	13	9	10	1	6	4	8	7	11	96
	Prevailing direction wind	NW	NW	SE	NW	SE	SE	NE	SE	SW	N	NW	NW	SW
Arborville	Mean temperature	22.4	26.6	33.8	48.3	58.7	70.2	75.8	72.3	72.8	54.5	35.4	23 8	49.6
	Highest temperature	47	59	66	80	90	96	102	96	101	92	71	50	102
	Lowest temperature	-8	-16	-4	27	26	40	50	46	46	30	-10	-12	-16
	Precipitation	1.72	0 83	2.61	4.80	3.02	4.22	1.12	1.60	1.02	5.57	0.65	0.80	27.96
	No. rainy days	3	3	7	15	5	12	4	7	2	7	3	6	74
	No. cloudless days	15	12	14	9	20	13	25	24	27	21	20	18	218
	No. partly cloudy days	6	9	9	14	9	16	6	5	3	5	5	4	91
	No. cloudy days	10	7	8	7	2	1	0	2	0	5	5	9	56
	Prevailing direction wind	NW	NW	SE	NE	SE	NE	SE	NE	S	NW	NW	NW	NW
Arcadia	Mean temperature	24.6	29.3	35.9	49.2	60.4	69.6	.....	72.5	70.2	.....	.....	.....	.....
	Highest temperature	65	60	72	90	92	101	.....	104	100	.....	.....	.....	.....
	Lowest temperature	-12	-4	6	28	28	44	.....	44	36	.....	.....	.....	.....
	Precipitation	0.82	0.30	2.50	7.04	1.25	5.19	1 47	2.11	1.45	.....	.....	.....	.....
	No. rainy days	4	3	6	6	2	11	4	8	4	.....	.....	.....	.....
	No. cloudless days	24	.....	12	15	23	13	23	.....	25	.....	.....	.....	.....
	No. partly cloudy days	0	.....	10	7	5	14	7	.....	4	.....	.....	.....	.....
	No. cloudy days	7	.....	9	8	3	3	1	.....	1	.....	.....	.....	.....
	Prevailing direction wind	.....	N	NE	N	.....	SE	S	S	S	.....	.....	.....	.....
Ashland	Mean temperature	23.5	28.1	35.0	50.3	61.4	72.6	79.7	72.4	74.8	58.9	36.6	20.4	51.1
	Highest temperature	50	62	66	78	90	98	101	98	103	92	73	49	103
	Lowest temperature	-10	-10	-7	28	36	41	52	45	41	31	-4	-26	-26
	Precipitation	0.32	0.43	1.23	7.29	2.12	2.31	1.66	1.44	3.70	3.39	0.25	1.13	25.27
	No. rainy days	3	5	5	14	8	9	7	9	3	6	2	6	77
	No. cloudless days	13	5	8	4	14	8	16	15	23	18	12	14	150

Digitized by Google

METEOROLOGICAL DATA—*Continued.*

Station.	Data.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Ashland.....	No. partly cloudy days....	11	20	15	19	16	21	14	12	4	7	12	9	160
	No. cloudy days.....	7	3	8	7	1	1	1	4	3	6	6	8	55.
	Prevailing direction wind.	N. W.	.....	N	NE	SE	SE	S	NE	S	S	N	N	S
Ashton.....	Mean temperature.....	22.0	27.6	34.0	48.8	60.6	70.3	77.1	72.1	73.5	54.9	33.2	23.4	49.8
	Highest temperature.....	56	56	69	80	92	98	102	99	98	88	79	52	102
	Lowest temperature.....	-12	-7	-3	27	31	39	51	45	40	29	-8	-10	-12
	Precipitation.....	0.23	0.46	1.48	5.01	48	5.14	1.30	2.35	1.94	4.92	0.32	0.28	23.91
	No. rainy days.....	3	6	7	13	5	15	7	7	3	6	4	3	79
	No. cloudless days.....	8	2	6	7	13	5	25	19	24	15	12	4	150
	No. partly cloudy days....	14	20	15	12	15	20	5	9	4	9	10	16	139
	No. cloudy days.....	9	6	10	11	3	5	1	3	2	7	8	11	76
	Prevailing direction wind	NW	NW	SE	NW	SE	SE	SE	SE	S	S	N	NW	SE
Auburn	Mean temperature.....	24.2	30.6	38.9	52.6	62.2	74.6	79.0	74.5	76.9	59.5	37.4	22.5	52.7
	Highest temperature.....	56	54	70	84	90	100	105	102	101	93	79	53	105
	Lowest temperature.....	-10	-7	-9	28	37	44	54	45	40	30	-2	-18	-18
	Precipitation.....	1.02	0.99	2.17	4.54	5.26	2.19	4.53	3.74	3.38	2.37	0.18	1.47	31.84
	No. rainy days.....	5	6	8	11	9	11	9	9	3	5	2	5	83
	No. cloudless days.....	15	5	9	8	15	6	19	16	23	21	15	12	164
	No. partly cloudy days...	7	12	8	13	7	19	12	10	5	5	10	9	117
	No. cloudy days.....	9	11	14	9	9	5	0	5	2	5	5	10	84
	Prevailing direction wind	NW	NW	N	NW	SW	SW	SW	NE	SW	SW	SW	NW	SW
Aurora.....	Mean temperature.....	24.6	28.0	35.6	50.6	62.1	75.3	83.6	77.4	73.4	56.9	34.9	24.8	52.3
	Highest temperature.....	50	60	78	82	88	94	104	98	100	94	78	64	104
	Lowest temperature.....	-6	-7	7	32	42	48	58	58	47	32	0	-4	-7
	Precipitation.....	0.62	0.80	2.31	3.79	2.09	5.35	1.07	2.94	2.07	5.58	0.22	1.90	28.72
	No. rainy days.....	2	2	6	12	6	12	3	8	3	6	1	4	65
	No. cloudless days.....	18	19	17	10	17	11	26	24	25	16	13	14	210
	No. partly cloudy days....	0	0	8	9	6	13	4	3	0	7	6	7	63
	No. cloudy days.....	13	9	6	11	8	6	1	4	5	8	11	10	92
	Prevailing direction wind.	NW	NW	SE	NW	SE	SE	SE	SE	S	SE	NW	NW	SE
Bassett.....	Mean temperature.....	18.0	24.0	27.1	46.9	60.1	65.8	72.3	67.6	.....	.....	.....	.....	.....
	Highest temperature.....	57	50	63	84	92	92	102	98	.....	.....	.....	.....	.....
	Lowest temperature.....	-19	-12	-12	20	25	38	47	41	.....	.....	.....	.....	.....
	Precipitation.....	1.50	1.30	2.35	1.72	1.13	3.39	3.50	1.24	.....	.....	.....	.....	.....

Digitized by Google

METEOROLOGICAL DATA—*Continued.*

STATION.	DATA.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Bassett.....	No. rainy days.....	7	8	5	6	6	9	6	7	.....	.....	.....	.....	.....
	No. cloudless days	15	12	.....	.....	21	12	27	17	.....	.....	.....	.....	.....
	No. partly cloudy days....	2	6	.....	.....	4	5	3	7	.....	.....	.....	.....	.....
	No. cloudy days.....	14	10	.....	.....	6	13	1	7	.....	.....	.....	.....	.....
	Prevailing direction wind.	NW	S	NW	.....	S	S	S	NW	.....	.....	.....	.....	.....
Beatrice.....	Mean temperature.....	23.4	27.3	36.0	50.2	60.6	72.2	78.8	71.6	72.8	58.7	37.4	23.5	51.0
	Highest temperature.....	50	63	72	81	88	98	102	100	100	90	72	62	102
	Lowest temperature.....	-11	-5	-6	29	34	42	52	46	41	28	6	-17	-17
	Precipitation	0.30	0.60	4.20	6.54	2.41	4.29	4.76	5.12	1.02	3.92	0.30	1.90	35.36
	No. rainy days.....	2	3	5	10	6	10	3	3	3	5	1	4	55
	No. cloudless days.....	12	4	6	5	12	12	.....	18	17	16	4	3	.....
	No. partly cloudy days...	13	17	16	23	19	18	.....	10	12	12	24	24	.....
	No. cloudy days	6	7	9	2	0	0	.....	3	1	3	2	4	.....
	Prevailing direction wind	NW	NE	NW	SE	SW	SE	S	SE	S	S	S	N	S
Beaver City..	Mean temperature.....	27.6	33.0	39.6	51.2	62.6	70.4	78.1	73.9	73.5	57.2	38.9	25.6	52.6
	Highest temperature.....	61	64	78	87	91	99	107	102	106	94	80	61	107
	Lowest temperature.....	-14	-3	3	29	31	41	51	47	42	28	-7	-19	-19
	Precipitation	0.28	0.38	1.30	5.30	0.85	3.54	3.13	1.50	2.16	4.81	0.39	1.09	24.73
	Rainy days.....	4	5	6	10	5	10	7	6	5	6	2	4	70
	No. cloudless days.....	17	10	16	15	19	14	26	22	25	18	18	19	214
	No. partly cloudy days....	5	9	7	5	10	12	2	4	3	12	5	3	77
	No. cloudy days.....	9	9	8	10	2	4	3	5	2	6	7	9	74
	Prevailing direction wind.	NW	NW	SE	NE	SE	SE	SE	NE	S	S	NW	NW	NW
Benkleman...	Mean temperature.....	23.7	35.2	38 2	48.2	61.7	69.4	75.9	72.2	70.2	53.6	38.2	28.8	51.3
	Highest temperature.....	60	70	70	86	98	104	106	104	98	90	78	62	106
	Lowest temperature.....	-9	8	10	30	42	46	54	56	44	28	6	-6	-9
	Precipitation.....	0.08	0.57	0.85	1.12	0.25	3.66	2.03	3.78	1.65	2.60	0.15	0.45	17.52
	Rainy days.....	2	3	3	3	1	10	7	6	2	5	1	3	46
	No. cloudless days	11	.....	11	12	3	8	20	.....	24	11	11	9	.....
	No. partly cloudy days....	13	.....	16	12	25	22	7	.....	3	14	15	16	.....
	No. cloudy days.....	7	.....	4	6	3	0	4	.....	3	6	4	6	.....
	Prevailing direction wind.	NW	SW	NE	N	S	NW	SW	SE	S	NE	SE	NW	NW
Blair.....	Precipitation	0.82	0 64	1.65	5.81	3.77	2.08	1.09	3.64	0.59	1.51	0.12	1.70	23.42

Digitized by Google

METEOROLOGICAL DATA—*Continued.*

STATION.	DATA.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Blue Hill.....	Mean temperature.....	25.1	29.3	38.0	50.7	63.0	71.2	77.6	73.4	73.2	57.6	36.5	24.7	51.7
	Highest temperature.....	52	63	70	80	89	94	104	99	102	92	72	55	104
	Lowest temperature.....	-6	-1	5	33	38	47	58	58	48	33	2	-10	-10
	Precipitation.....	0.68	0.55	0.83	5.92	2.40	7.68	1.94	2.52	3.12	5.90	0.68	0.68	32.95
	No. rainy days.....	2	2	3	10	5	12	4	3	3	4	2	3	53
	No. cloudless days.....	14	5	14	9	17	8	18	13	24	16	15	14	167
	No. partly cloudy days....	2	13	6	9	11	19	13	15	6	9	10	7	120
	No. cloudy days.....	15	10	11	12	3	3	0	3	0	6	5	10	78
	Prevailing direction wind.	NW	NE	SE	NW	S	S	S	NE	S	S	N	NW	S
Broken Bow.	Mean temperature.....	24.2	29.5	35.6	50.0	67.0	75.0	79.4	71 6	69.5	49.4	36.4	32.2	51.7
	Highest temperature.....	60	55	70	90	90	96	101	95	95	85	70	80	101
	Lowest temperature.....	-10	2	0	30	48	50	60	40	45	28	-5	0	-10
	Precipitation.....	0.10	0.55	1.60	5.40	0.37	4.28	1.11	1.36	1.14	4.03	0.40	1.15	21.49
	Rainy days.....	1	5	3	8	1	12	4	5	5	5	2	3	54
	No. cloudless days.....	21	13	16	12	17	12	19	12	20	16	8	18	184
	No. partly cloudy days....	2	2	0	1	7	7	6	12	3	3	3	1	47
	No. cloudy days.....	8	13	15	17	7	11	6	7	7	12	19	12	134
	Prevailing direction wind.	NW	.....	NE	.....	SE	SE	SE	.....	S	SW	.....	.....	.....
Burchard.....	Precipitation.....	0.75	1.00	2.85	7.15	2.50	3.37	5.87	4.42	4.35	3.81	0.05	0.90	37.02
Burwell.....	Mean temperature	20.5	24.1	32.2	48.1	60.8	75.1	77.7	71.7	71 0	50.0	32.1	20.2	48.2
	Highest temperature.....	54	48	68	76	86	94	102	98	92	86	64	48	102
	Lowest temperature.....	-14	-8	0	30	40	42	60	52	54	28	-10	-10	-14
	Precipitation.....	0.50	0.40	1.60	3.24	0.60	2.44	1.87	1.41	T	3.89	0.20	1.55	17.70
	No. rainy days	4	2	3	4	2	9	4	6	0	5	2	4	45
	No. cloudless days.....	19	20	19	17	26	16	27	24	28	20	18	14	248
	No. partly cloudy days..	2	3	6	7	2	9	2	4	2	4	9	8	58
	No. cloudy days.....	10	5	6	6	3	5	2	3	0	7	3	9	59
	Prevailing direction wind	NW	NW	S	NW	S	NW	S	NW	S	S	NW	NW	NW
Callaway	Mean temperature.....	22.2	27.2	33.8	47.2	59.8	67.8	74.6	68.9	67.4	50.5	36.1	22.6	48.2
	Highest temperature.....	61	52	69	80	85	93	101	97	97	91	72	53	101
	Lowest temperature.....	-12	0	5	25	29	47	48	42	37	25	-2	-12	-12
	Precipitation.....	0.35	0.48	1.28	5.30	0.30	4.95	0.70	1.78	1.15	5.00	0.30	0.95	18.04
	No. Rainy Days.....	2	2	5	9	2	10	3	6	4	5	2	4	54
	No. clear days.....	20	19	20	16	27	20	29	23	28	18	18	20	258

Digitized by Google

METEOROLOGICAL DATA—*Continued.*

STATION.	DATA.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Callaway.....	No. partly cloudy days ...	3	4	4	9	4	7	0	4	0	4	5	2	46
	No. cloudy days.....	8	5	7	5	0	3	2	4	2	9	7	9	61
	Prevailing direction wind	N	N	N	NW	N	NE	S	S	SW	W	NW	NW	N
Camp Clark..	Mean temperature.....	.....	.....	.....	.....	.....	68.6	70.1	70.1	67.3	51.4	36.0	23.1	.....
	Highest temperature.....	.....	.....	.....	.....	.....	102	104	102	102	90	79	56	.....
	Lowest temperature.....	.....	.....	.....	.....	.....	41	34	42	30	20	-6	-21	.....
	Precipitation.....	.....	.....	.....	.....	0.85	1.01	3.79	3.88	0.41	0.28	0.72	1.10	.....
	No. rainy days.....	.....	.....	.....	.....	6	6	6	8	4	6	4	4	.....
	No. cloudless days.....	.....	.....	.....	.....	9	3	14	21	18	15	18	22	.....
	No. partly cloudy days....	.....	.....	.....	.....	21	18	12	8	9	13	8	6	.....
	No. cloudy days.....	.....	.....	.....	.....	1	9	5	2	3	3	4	3	.....
	Prevailing direction wind.	.....	.....	.....	.....	E	NE	NW	E	S	N	NW	NW	.....
Central City..	Mean temperature.....	23.8	30.2	38.4	55.2	69.7	76.2	85.0	76.6	.....	50.2	36.1	22.8	.....
	Highest temperature	50	52	75	79	87	97	98	94	.....	70	68	50	98
	Lowest temperature.....	-6	0	9	36	54	51	60	65	.....	32	-4	-6	-6
	Precipitation	0.91	0.60	1.35	6.10	1.75	3.75	2.38	2.07	2.96	3.97	0.70	1.10	27.64
	No. rainy days.....	3	2	3	6	3	6	3	5	5	5	4	4	49
	No. cloudless days.....	15	6	19	18	.....	21	28	24	.....	18	15	15	.....
	No. partly cloudy days...	7	16	0	0	.....	9	0	7	.....	1	0	0	.....
	No. cloudy days.....	9	6	12	12	.....	0	3	0	.....	12	15	16	.....
	Prevailing direction wind	N	N	NW	NW	NW	NW	SE	NE	.....	N	N	N	N
Chester	Mean temperature.....	23.9	28.6	38.8	48.6	60.0	71.0	78.2	73.5	76.6	55.5	36.8	23.2	51.2
	Highest temperature.....	50	55	74	82	85	92	100	98	104	90	70	56	104
	Lowest temperature.....	-6	-3	3	34	38	50	60	54	50	30	0	-9	-9
	Precipitation	0.50	0.20	0.78	4.99	1.93	10.00	7.44	2.50	1.05	6.16	0.75	1.30	37.60
	Rainy days.....	2	1	5	8	7	12	4	3	3	7	1	6	59
	No. cloudless days.....	8	2	8	4	8	0	20	15	25	14	7	5	116
	No. partly cloudy days....	12	19	14	19	22	27	11	12	5	11	17	17	186
	No. cloudy days.....	11	7	9	7	1	3	0	4	0	6	6	9	63
	Prevailing direction wind.	N	S	N	N	S	S	S	S	S	S	S	N	S
Columbus.....	Mean temperature.....	20.9	27.0	33.1	49.0	60.2	69.4	71.8	69.6	68.9	56.0	34.3	21.4	48.5
	Highest temperature.....	52	59	65	78	88	95	97	100	94	87	70	49	100
	Lowest temperature.....	-12	-12	-1	27	33	42	48	46	39	30	-8	-13	-13
	Precipitation	0.69	0.66	1.90	5.10	1.12	3.15	2.67	3.11	2.22	3.85	0.15	1.47	26.09

Digitized by Google

METEOROLOGICAL DATA—*Continued.*

Station.	Data.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Columbus.....	No. rainy days.....	4	5	8	13	5	10	7	6	3	5	3	7	76
	No. clear days.....	13	8	8	8	11	2	7	7	19	10	11	9	113
	No. partly cloudy days...	6	14	10	11	19	25	24	20	10	16	9	10	174
	No. cloudy days.....	12	6	13	11	1	3	0	4	1	5	10	12	78
	Prevailing direction wind	NW	SW	SE	NW	NW	SE	SE	SE	SW	SW	NW	NW	NW
Cornlea.....	Precipitation	1.47	0.44	1.65	4.64	2.69	5.62	3.50	3.46	1.62	3.85	0.27	1.16	30.37
Creighton.....	Mean temperature.....	15.4	20.8	28.6	46.6	58.6	70.0	74.2	69.8	73.6	51.7	31.5	19.4	46.7
	Highest temperature.....	47	48	59	84	88	104	100	98	98	88	76	47	104
	Lowest temperature.....	-17	-19	-9	23	27	37	49	42	29	2[illegible]	-12	-12	-19
	Precipitation.....	2.1	0.75	2.58	5.88	0.65	3.73	2.58	1.69	0.90	2.11	0.30	1.50	24.77
	No. rainy days.....	4	2	6	13	2	11	7	8	3	7	2	5	70
	No. cloudless days.....	0	1	4	2	.....	1	9	0	.....	1	3	8	.....
	No. partly cloudy days....	18	17	11	18	.....	23	18	26	.....	23	20	7	.....
	No. cloudy days.....	13	10	16	10	.....	6	4	5	.....	7	7	16	.....
	Prevailing direction wind	.....	S	N	N	S	S	S	S	.....	S	S	S	S
Crete.....	Mean temperature.....	23.4	29.6	36.4	50.8	60.4	71.4	77.5	71.3	73.4	58.9	37.6	22.0	51.1
	Highest temperature	50	63	71	79	86	99	99	97	99	91	72	54	99
	Lowest temperature.....	-10	-9	-6	29	35	43	54	48	43	31	-3	-20	-20
	Precipitation	1.45	0.90	3.07	4.38	1.69	2.41	3.73	3.50	1.11	4.23	0.35	11.00	27.92
	Rainy days	4	4	11	16	8	9	5	12	4	7	3	6	88
	No. cloudless days.....	13	5	10	10	16	5	11	4	22	13	8	11	128
	No. partly cloudy days ...	8	14	11	7	12	19	16	17	6	11	11	7	139
	No. cloudy days.....	10	9	10	13	3	6	4	10	2	7	11	13	98
	Prevailing direction wind	N	N	N	N	SE	S	SE	NE	S	S	N	N	N
Culbertson...	Precipitation	0.71	0.77	1.90	4.73	0.75	8.67	1.29	2.95	1.13	4.84	0.38	0.85	28.97
Curtis.....	Mean temperature.....	28.8	33.1	40.8	50.3	64.2	70.6	77.5	72.2	72.2	55.0	39.5	27.7	52.7
	Highest temperature	68	74	76	89	91	100	104	101	101	90	79	59	104
	Lowest temperature.....	-11	3	5	28	34	46	53	49	43	19	0	-11	-11
	Precipitation	T	0.50	2.58	5.10	0.43	4.08	0.60	3.26	1.27	4.73	1.50	1.10	25.25
	Rainy days	0	2	6	8	2	13	5	7	4	6	2	3	58
	Clear days.....	20	7	17	16	17	7	27	21	27	18	19	18	214
	Partly cloudy days.....	6	12	8	7	12	10	1	9	1	9	8	8	91
	Cloudy days.....	5	9	6	7	2	13	3	1	2	4	3	5	60

Digitized by Google

METEOROLOGICAL DATA.—*Continued.*

STATION.	DATA.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Curtis.....	Prevailing direction wind.	NW	N	NW	NW	S	E	SE	SE	S	S	NW	NW	NW
David City....	Mean temperature.....	21.1	26.6	33.6	48.2	60.4	70.5	77.8	67.4	72.0	55.4	33.6	22.0	49.0
	Highest temperature.....	46	56	62	76	86	94	100	94	94	89	68	48	100
	Lowest temperature.....	-12	-11	1	33	42	48	60	54	45	34	-8	-8	-12
	Precipitation.....	0.95	0.50	1.75	6.60	2.65	2 00	1.90	3.30	1.10	4.10	0.30	1.80	26.45
	No. rainy days.....	4	1	3	9	4	7	6	7	3	5	2	4	55
	No. cloudless days	9	5	8	9	17	10	16	16	22	13	10	9	144
	No. partly cloudy days....	11	20	12	9	8	12	14	10	8	8	12	13	137
	No. cloudy days...	11	3	11	12	6	8	1	5	0	10	8	9	84
	Prevailing direction wind	NW	NW	N	NW	S	S	S	S	S	S	S	NW	S
Dawson.....	Precipitation.....	.....	.....	.....	.....	.....	3.42	3.20	5.93	3.86	3.70	0.30	1.60	.....
Divide	Precipitation.....	0.22	0.56	1.12	4.23	0.61	5.77	0.72	2.74	2.10	4.88	0.34	1.15	24.44
Dunning.....	Mean temperature.....	20.0	29.0	33.6	46.4	62.5	71.0	77.0	75.2	74.4	53.8	35.5	27.9	50.5
	Highest temperature.....	57	47	54	77	88	97	105	99	97	84	67	48	105
	Lowest temperature.....	-14	12	4	31	27	47	58	55	48	20	0	-3	-14
	Precipitation.....	0.50	0.20	26	3.11	0.34	3.89	1.55	1.91	0 46	1.78	0.40	1.50	15.90
	No. rainy days.....	3	2	5	3	3	7	3	6	2	5	5	4	46
	No. cloudless days.....	18	14	9	10	19	11	20	16	24	16	10	17	184
	No. partly cloudy days....	0	7	16	13	12	11	9	12	5	7	12	10	114
	No. cloudy days.....	13	7	6	7	0	8	2	3	1	8	8	4	67
	Prevailing direction wind	NW	NW	S	SW	SE	SE	SE	SW	SW	NW	NW	SW	NW
Eden.....	Precipitation.....	0.90	0.70	2.45	4.72	4.00	3.11	4.85	6.11	3.49	2.66	0.17	1.40	34.56
Edgar.....	Mean temperature.....	23.8	28.2	36.6	49.1	63.3	73.5	79.6	73.8	75.1	57.2	36.3	24.5	51.8
	Highest temperature.....	49	52	66	78	88	95	105	100	98	90	68	54	105
	Lowest temperature.....	-7	-7	8	33	40	43	59	53	48	30	0	-15	-15
	Precipitation.....	1.20	0.55	1.08	5.02	4.44	6.00	1.62	4.17	3.15	6.82	0.40	1.40	35.85
	No. rainy days.....	3	3	4	11	7	10	4	8	5	6	1	4	61
	No. cloudless days.....	10	3	8	10	19	6	22	19	23	19	10	10	159
	No. partly cloudy days....	11	20	14	10	7	20	9	9	2	6	11	8	127
	No. cloudy days.....	10	5	9	10	5	4	0	3	5	6	9	13	79
	Prevailing direction wind.	NW	SE	SE	NW	SE	SE	SE	SE	SE	SE	SE	NW	SE

Digitized by Google

METEOROLOGICAL DATA—*Continued.*

STATION.	DATA.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Elba	Precipitation	0.19	0.90	1.58	4.83	0.56	4.79	1.46	2.38	1.53	5.70	0.05	1.60	25.07
Ericson	Mean temperature	20.2	23.8	32.1	47.8	66.0	74.3	82.2	73.1	74.4	51.2	31.7	20.2	49.8
	Highest temperature	53	45	72	80	92	102	103	99	98	87	55	30.9	103
	Lowest temperature	-12	-9	3	33	45	45	66	56	47	30	-15	-18	-18
	Precipitation	1.00	0.50	2.64	4.25	2.07	3.85	1.98	2.61	0.87	3.84	0.10	1.50	25.21
	No. rainy days	3	2	4	6	3	10	5	5	2	5	1	3	49
	No. cloudless days	16	8	13	11	19	15	22	22	19	14	13	15	187
	No. partly cloudy days	4	15	10	11	8	11	8	6	9	8	9	6	105
	No. cloudy days	11	5	8	8	4	4	1	3	2	9	8	10	73
	Prevailing direction wind	N	SE	S	N	S	S	S	SE	S	S	N	N	S
Ewing	Precipitation	0.90	0.50	1.93	4.34	0.30	3.03	2.76	1.90	0.76	3.77	0.05	2 40	22.64
Fairbury	Mean temperature	25.2	29.2	33.3	51.6	61.8	69.4	79.6	73.0	72.4	57.6	37.2	24.0	51.6
	Highest temperature	50	64	77	84	89	101	102	102	101	92	75	58	102
	Lowest temperature	-8	-4	-5	28	28	40	53	46	37	28	1	-19	-19
	Precipitation	0.44	0.20	1.00	3.35	3.65	5.82	6.26	3.37	1.37	4.97	0.36	1.40	32.31
	No. rainy days	5	2	5	11	7	12	6	4	3	8	1	6	70
	No. cloudless days	14	11	14	16	12	16	16	16	24	20	17	15	151
	No. partly cloudy days	11	14	11	8	17	12	15	13	5	5	7	7	125
	No. cloudy days	6	3	6	6	2	2	0	2	1	6	6	9	49
	Prevailing direction wind	NW	NW	NW	NW	S	NE	S	SW	S	SW	NW	N	NW
Fairmont	Mean temperature	24.9	29.4	37.8	49.0	60.2	69.7	77.5	72.0	73.2	59.2	35.2	20.8	50.7
	Highest temperature	48	60	72	80	89	96	102	103	101	92	72	57	103
	Lowest temperature	-7	-6	5	28	34	41	52	45	43	29	-6	-21	-21
	Precipitation	0.63	0.84	2.68	4.72	2.06	4.21	2.06	2.48	2.31	5.95	0.33	1.65	29.92
	No. rainy days	2	3	6	14	8	14	4	6	2	5	3	5	72
	No. cloudless days	14	12	15	13	19	17	23	18	21	22	16	15	205
	No. partly cloudy days	1	3	5	7	6	10	7	7	6	4	5	3	69
	No. cloudy days	16	8	11	10	6	3	1	6	3	5	9	13	91
	Prevailing direction wind	NW	SW	NW	NW	NW	S	S	S	S	N	N	N	NW
Ft. Robinson	Mean temperature	22.6	26.2	31.2	44.0	60.2	64.0	70.8	68.8	67.2	50.5	32.2	25.0	46 9
	Highest temperature	63	52	70	82	90	94	101	101	97	86	77	58	101
	Lowest temperature	-21	5	-14	28	27	38	40	45	38	23	-8	-18	-21
	Precipitation	1.90	T	0.50	0.40	0.65	1.49	3.60	T	T	T	0.65	1.30	10.49

Digitized by Google

METEOROLOGICAL DATA—*Continued.*

STATION.	DATA.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Ft. Robinson	No. rainy days	3	0	1	1	2	5	5	0	0	0	3	1	22
	Prevailing direction wind	SW	SW	SW	SW	SE	SW	SE	SW	SW	SW	SW	SW	SW
Franklin	Mean temperature	25.9	30.8	38 8	.....	64.6	71.4	79.5	73.4	75.8	59.2	38.6	27 8	.....
	Highest temperature	60	50	81	.....	101	105	112	106	113	97	81	65	113
	Lowest temperature	-11	0	3	.....	32	38	52	41	43	28	-2	-11	-11
	Precipitation	0.60	0.55	0.61	.....	1.13	5.50	2.45	3.53	2.46	5.99	0.44	1.40	.....
	No. rainy days	1	3	3	.....	4	11	8	5	5	7	2	3	.....
	No. cloudless days	.....	12	17	.....	16	5	27	13	26	19	13	.....	.....
	No. partly cloudy days	.....	11	1	.....	11	17	4	12	3	7	11	.....	.....
	No. cloudy days	.....	5	13	.....	4	8	0	6	1	5	6	.....	.....
	Prevailing direction wind	N	S	SE	.....	N	S	S	N	S	N	N	N	N
Fremont	Mean temperature	20.1	28.0	33.4	48.8	59.6	70.2	76.6	69.7	71.4	56.1	34.4	20.2	49.0
	Highest temperature	45	57	63	79	88	94	100	97	96	90	72	46	100
	Lowest temperature	-12	-14	2	26	34	41	49	44	38	30	-12	-21	-21
	Precipitation	0.92	0.60	1.90	5.61	0.86	2.68	1.23	2.27	0.56	2.77	0.22	2.05	21.67
	No. rainy days	3	1	9	13	8	11	5	8	5	7	3	6	78
	No. cloudless days	13	8	11	11	12	15	28	21	27	17	9	7	179
	No. partly cloudy days	6	17	11	5	18	12	3	5	3	9	17	12	118
	No. cloudy days	12	3	9	14	1	3	0	5	0	5	4	12	68
Geneva	Mean temperature	24 8	28.4	36.2	51.9	61.2	72.4	77.4	71.4	72.3	57.4	36.4	23.5	51,0
	Highest temperature	50	63	76	88	88	99	103	100	101	91	72	47	103
	Lowest temperature	-10	-10	-3	29	33	43	50	44	42	30	-3	-20	-20
	Precipitation	0.60	0.93	1.61	4.69	2.61	4.42	2.39	3.04	2.94	5.79	0.45	1.05	30.52
	No. rainy days	6	3	7	8	7	13	5	7	4	6	2	5	73
	No. cloudless days	5	0	2	8	8	1	11	11	19	7	3	3	278
	No. partly cloudy days	14	22	18	11	20	27	19	17	9	19	22	15	-18
	No. cloudy days	12	6	11	11	3	2	1	3	2	5	5	13	74
	Prevailing direction wind	NW	SE	SE	NW	SE	SE	SE	SE	SE	S	NW	NW	SE
Genoa	Mean temperature	20.1	20.4	32.9	48.6	60.4	70.1	75.7	70.6	71.9	55.8	34.2	21.7	49.0
	Highest temperature	46	54	62	78	90	97	100	96	97	89	70	49	100
	Lowest temperature	-11	-12	-5	28	33	40	54	45	42	30	-7	-9	-12
	Precipitation	1 36	0.64	1.81	5.47	1.64	3.80	4.59	2.93	2 71	4.12	0.84	1.44	30.85
	No. rainy days	5	7	9	9	6	12	8	7	4	5	5	9	86
	No. cloudless days	12	7	11	7	19	8	20	15	22	14	9	8	152

Digitized by Google

METEOROLOGICAL DATA—*Continued.*

Station.	Data.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Genoa	No partly cloudy days	7	8	5	9	6	12	8	10	3	6	11	7	92
	No. cloudy days	12	13	15	14	6	10	3	6	5	11	10	16	121
	Prevailing direction wind	NW	NW	NW	NW	NW	S	S	NE	SW	N	NW	NW	NW
Gering	Mean temperature	23.4	29.2	34.0	46.6	61.0	68.4	70 8	70.2	67.1	50.2	36 9	22 8	48.4
	Highest temperature	62	60	76	84	92	100	104	99	97	88	72	53	104
	Lowest temperature	−20	−1	−5	16	26	37	38	41	33	16	−9	−19	−20
	Precipitation	0.19	0 30	1.08	1.40	1.79	0.67	2.76	1.96	0.30	0.10	0.68	0 40	11.63
	No. rainy days	3	4	7	7	4	7	6	5	2	2	6	1	54
	No. cloudless days	20	15	11	17	19	13	23	25	25	25	22	21	236
	No. partly cloudy days	5	2	6	3	4	0	0	0	5	0	0	0	25
	No. cloudy days	6	11	14	10	8	17	8	8	0	6	8	10	104
	Prevailing direction wind	NW	NW	E	NW	SE	SE	W	SE	SE	W	W	W	SE
Gothenburg	Mean temperature	23.0	28.6	36.4	49.6	64.1	69.8	78.0	71.7	70.2	52.7	35.2	23.6	50.2
	Highest temperature	60	56	71	84	98	106	108	97	100	88	80	55	108
	Lowest temperature	−11	3	3	24	27	44	48	47	40	22	−3	−8	−11
	Precipitation	0.44	0.70	1.06	4.85	0 55	4.45	0.70	3.10	1.71	4.67	0.70	1.50	24.43
	No. rainy days	2	3	6	9	1	9	5	4	5	7	3	5	59
	No. cloudless days	19	2	7	15	17	7	17	9	21	14	7	12	147
	No. partly cloudy days	3	15	15	6	13	18	12	16	7	10	21	12	148
	No. cloudy days	9	11	9	9	1	5	2	6	2	7	2	7	70
	Prevailing direction wind	NW	NW	NW	NW	SE	SE	SE	SE	S	NW	NW	NW	NW
Grand Island	Mean temperature	23.2	28.8	37.2	49.0	60.3	69.4	76.6	71.2	72.6	55.9	35.0	23.0	50.2
	Highest temperature	54	59	73	79	88	93	104	97	100	89	70	53	104
	Lowest temperature	−10	−6	−3	28	31	42	52	46	45	32	−3	−8	−10
	Precipitation	0.70	0.69	2.54	7.01	1.59	5.34	2.40	2.40	2.15	6.28	0.65	1.71	33.46
	No. rainy days	4	5	5	15	5	18	8	8	5	6	5	7	89
	No. cloudless days	14	10	13	9	16	6	22	20	22	11	15	9	167
	No. partly cloudy days	5	9	8	10	13	17	8	9	6	9	5	7	106
	No. cloudy days	12	9	10	11	2	7	1	2	2	11	10	15	92
	Prevailing direction wind	N	N	N	N	S	S	S	S	S	S	N	N	N
Greeley	Mean temperature	21.0	24 0	32.6	48.4	67.4	75.8	.....	74.3	.....	.....	.....	20.3	.....
	Highest temperature	53	45	72	80	92	103	.....	100	.....	.....	.....	40	.....
	Lowest temperature	12	−9	3	34	45	45	.....	57	.....	.....	.....	−20	.....
	Precipitation	0.58	0.50	0.31	6.15	1.90	7.18	0.90	2.60	1.85	2.00	.....	1.00	.....

Digitized by Google

METEOROLOGICAL DATA—*Continued*

STATION.	DATA.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Greeley.....	No. rainy days.....	3	2	2	5	3	7	3	4	2	2	.....	1	.....
	No. cloudless days.....	16	8	17	13	19	.....	.....	20	19	14	.....	15	.....
	No. partly cloudy days.....	3	16	7	6	8	.....	.....	6	4	5	.....	10	.....
	No. cloudy days.....	12	4	7	11	4	.....	.....	5	4	11	.....	6	.....
	Prevailing direction wind	N	SE	S	N	S	S	.....	S	S	S	.....	N	.....
Haigler.....	Precipitation	T	T	0.70	2.58	1.62	4.56	0.97	4.15	0.51	1.80	0.40	0.20	17.49
Harrison Pct	Mean temperature....	24.4	30.0	35.9	48.5	62.9	69.4	77.2	72.2	70.8	.....	.....	22.7	.....
	Highest temperature	59	62	69	84	88	98	100	97	98	.....	.....	42	.....
	Lowest temperature.....	-16	4	9	30	38	44	62	54	46	.....	.....	-8	.....
	Precipitation	0.80	0.47	1.10	5.23	0.74	6.31	0.75	0.82	1.88	4.86	.....	1.25	.....
	No. rainy days	3	3	4	11	2	11	3	5	4	5	.....	5	.....
	No. cloudless days.....	17	11	12	14	.....	.....	.....	17	.....	.....	.....	.....	.....
	No. partly cloudy days...	13	13	14	10	.....	.....	.....	9	.....	.....	.....	.....	.....
	No. cloudy days.....	1	4	5	6	.....	.....	.....	5	.....	.....	.....	.....	.....
	Prevailing direction wind	NW	NW	E	NW	SE	SE	SE	SE	S	.....	.....	.....	.....
Hartington..	Mean temperature.....	18.7	20.2	26.6	46.7	59.0	66.6	74.0	67.8	71.6	54.6	32.4	18.6	46.0
	Highest temperature.....	45	45	58	88	89	95	97	99	98	91	77	47	99
	Lowest temperature.....	-19	-20	-11	28	28	39	51	42	33	28	-9	-15	-20
	Precipitation.....	2.50	0.54	3.01	4.48	0.98	5.82	3.78	1.60	1.01	1.94	0.91	2.95	29.52
	No. rainy days.....	10	5	8	16	4	11	8	9	3	6	7	9	96
	No. cloudless days.....	11	3	10	7	21	13	22	18	24	18	16	12	175
	No. partly cloudy days....	7	14	6	11	5	11	6	8	5	4	5	6	88
	No. cloudy days.....	13	11	15	12	5	6	3	5	1	9	9	13	102
	Prevailing direction wind.	NW	S	NW	NW	S	S	S	N	S	S	N	NW	S
Harvard.....	Mean temperature.....	22.6	26.5	34.3	49.4	61.2	71.4	78.1	71.8	72.0	54.9	32	21.4	49.7
	Highest temperature.....	50	60	69	78	90	92	102	96	101	93	70	55	102
	Lowest temperature.....	-10	-10	4	31	43	49	50	54	46	32	-5	-19	-19
	Precipitation.....	1.25	0.60	1.86	4.19	3.06	3.74	1.70	2.56	1.34	4.27	0.57	1.62	26.85
	No. rainy days.....	2	2	3	15	8	15	7	8	5	8	3	6	82
	No. cloudless days.....	14	10	14	13	21	12	26	19	23	21	20	13	205
	No. partly cloudy days....	8	12	8	8	9	17	4	9	6	5	6	10	102
	No. cloudy days.....	9	6	9	9	1	2	1	3	1	5	4	8	58
	Prevailing direction wind.	N	S	SE	NW	S	S	S	NE	S	S	N	NW	S

Digitized by Google

METEOROLOGICAL DATA.—*Continued.*

STATION.	DATA.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Hastings.....	Mean temperature	24 5	28.4	35.5	49.6	61.4	70.5	77.1	71.0	71.9	54.3	33.4	23.8	50.1
	Highest temperature.....	50	60	69	81	89	91	98	96	99	91	72	55	99
	Lowest temperature.....	-6	-8	8	34	43	46	58	53	47	31	0	-10	-10
	Precipitation	0.27	0.38	1.18	4.89	2.82	6.23	3.89	2.91	2.33	5.82	0.60	1.39	33.58
	Rainy days.....	4	3	8	13	5	14	5	5	4	7	2	7	77
	No. cloudless days.....	10	5	7	7	17	6	20	20	20	16	13	10	151
	No. partly cloudy days...	11	17	10	8	11	20	10	9	9	9	13	7	134
	No. cloudy days.....	10	6	14	15	3	4	1	2	1	6	4	14	80
	Prevailing direction wind	NW	NW	NW	NW	SW	S	S	SE	S	NE	SW	NW	NW
Hay Springs.	Mean temperature.....	19.4	25.6	31.4	44.7	58.4	63.4	71.4	67.7	67.3	49.8	32.2	20.2	46.0
	Highest temperature.....	58	48	67	83	90	94	104	99	95	86	72	49	104
	Lowest temperature.....	-18	-2	-13	24	26	36	44	47	35	25	-9	-16	-18
	Precipitation.....	2.45	0.50	2.68	1.65	2.27	1.52	3.62	3.10	0.18	1.20	1.60	1.12	21.89
	No. rainy days.....	7	5	6	9	6	9	5	6	1	3	7	6	70
	No. cloudless days.....	17	11	11	13	13	5	14	18	21	15	6	17	161
	No. partly cloudy days....	5	13	12	8	13	18	13	10	6	12	14	9	133
	No. cloudy days.....	9	4	8	9	5	7	4	3	3	4	10	5	71
	Prevailing direction wind	NW	NW	SW	NW	S	NE	S	SE	SE	NW	NW	NW	NW
Hayes Center	Precipitation.....	0.20	0.34	1.86	3.36	0.37	4.36	2.09	2.32	1.19	3.22	0.30	0.50	20.11
Hebron.....	Mean temperature.....	25.4	27.4	38.2	51.1	60 9	71.3	76.8	72.0	73.6	58.2	36.9	23.9	51.3
	Highest temperature.....	51	66	77	83	88	97	99	98	101	92	73	58	101
	Lowest temperature.....	-8	-5	-2	27	33	42	52	45	40	30	0	-14	-14
	Precipitation	0.65	0.42	1.33	3.12	3.27	5.52	3.56	2.63	1.22	4.70	0.45	1.00	27.87
	No. rainy days.....	4	3	6	8	7	14	6	5	4	6	2	7	72
	Prevailing direction wind.	.....	.....	.....	.....	.....	.....	S	.....	.....	.....	.....	.....	.....
Hickman.....	Precipitation.....	0.45	0.40	1.40	4.13	2.36	1.68	5.13	3.13	1.68	2.03	0.03	1.80	24.22
Holdrege.....	Mean temperature.....	26.1	30.9	37.4	51.8	63.7	72.2	79.8	72.6	74.8	54.8	33.6	23.4	51.8
	Highest temperature	56	63	72	84	94	98	101	100	100	90	65	55	101
	Lowest temperature.....	-12	1	8	33	42	52	62	50	48	31	2	-7	-12
	Precipitation	0.70	1.01	2.30	5.80	2.80	3.45	3.85	0 95	2.90	4.35	0.27	1.00	28.78
	No. rainy days.....	3	2	3	7	3	10	5	3	1	5	2	5	49
	No. cloudless days.....	16	13	17	17	17	15	24	15	12	7	4	6	163
	No. partly cloudy days...	6	11	9	4	9	9	5	12	16	21	24	19	145

Digitized by Google

METEOROLOGICAL DATA—*Continued.*

STATION.	DATA.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Holdrege.....	No. cloudy days.....	9	4	5	9	5	6	2	4	2	3	2	6	57
	Prevailing direction wind	NW	NE	S	NW	S	S	S	N	SW	SW	SW	SW	SW
Imperial	Mean temperature.....	24.4	30.7	36.1	48.2	63.0	70.1	76.0	73.5	71.2	58.3	37.4	25.0	50.7
	Highest temperature.....	60	65	71	88	93	102	108	107	98	90	78	56	108
	Lowest temperature.....	-18	-1	-2	20	32	42	45	48	36	21	-4	-18	-18
	Precipitation.....	0.50	0.70	2.05	2.55	1.95	2.38	1.23	6.03	0.51	3.87	0.52	0.70	22.99
	No. rainy days.....	2	4	4	7	5	12	5	9	6	6	6	6	72
	No. cloudless days.....	15	5	14	17	17	8	22	10	16	13	13	16	166
	No. partly cloudy days....	13	19	12	6	14	20	5	16	11	9	9	5	139
	No. cloudy days.....	3	4	5	7	0	2	4	5	3	9	8	10	60
	Prevailing direction wind	NW	NW	SE	NW	SE	NW	SE	NW	SE	SE	NW	NW	NW
Kearney	Mean temperature.....	21.5	28.6	36.0	50.0	63.5	71.8	79.6	76.1	75.4	62.6	40.1	27.3	52.7
	Highest temperature.....	32	50	70	82	88	96	98	96	96	92	78	68	98
	Lowest temperature.....	-12	-1	8	30	40	50	60	56	46	28	1	-14	-14
	Precipitation.....	0.32	0.99	1.08	6.52	1.18	3.34	4.01	1.60	2.51	5.70	0.82	1.68	29.70
	No. rainy days.....	4	8	5	8	4	6	4	3	2	3	2	4	53
	No. cloudless days	15	8	9	11	19	13	16	15	22	21	14	20	183
	No. partly cloudy days....	2	8	15	11	11	5	10	6	6	4	3	1	82
	No. cloudy days.....	14	12	7	8	1	12	5	10	2	6	13	10	100
	Prevailing direction wind	N	W	NE	N	NE	N	S	N	S	N	N	W	N
Kennedy.....	Mean temperature.....	19.2	24.3	31.6	47.0	59.8	66.0	74.7	69.2	67.5	50.6	33.4	22.2	47.0
	Highest temperature	52	51	68	84	94	97	105	99	99	88	78	59	105
	Lowest temperature.....	-17	-12	-3	21	19	40	45	42	33	24	-11	-14	-17
	Precipitation	1.00	0.36	1.63	1.80	1.76	3.80	3.63	3.61	0.63	1.49	1.74	2.40	23.85
	No. rainy days.....	4	4	5	8	3	14	7	8	2	2	5	4	66
	No. cloudless days.....	21	19	18	20	26	15	26	20	23	16	19	21	244
	No. partly cloudy days...	5	6	9	4	5	11	2	7	6	11	5	6	77
	No. cloudy days.....	5	3	4	6	0	4	3	4	1	4	6	4	44
	Prevailing direction wind	NW	NW	SW	NW	S	SE	SE	SE	S	N	N	NW	NW
Kimball.....	Mean temperature.....	24.7	28.9	32.9	44.2	59.4	64.6	71.0	69.7	66.9	50.5	38.4	28.6	47.9
	Highest temperature	57	55	68	79	89	93	100	95	93	84	75	54	100
	Lowest temperature.....	-20	-3	-5	8	32	38	43	45	29	26	3	-16	-20
	Precipitation	0.20	0.75	1.70	1.10	3.86	2.16	6.42	1.66	0.44	0.88	0.60	1.15	20.92
	Rainy days	3	3	7	3	7	7	7	5	3	2	5	5	57

Digitized by Google

METEOROLOGICAL DATA—*Continued.*

Station.	Data.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Kimball.....	Prevailing direction wind	NW	NW	NW	NW	NW	SW	SW	SW	NW	NW	NW	NW	NW
Kirkwood.....	Mean temperature.....	15.4	19.8	24.8	46.6	60.7	67.2	74.7	70.5	72.0	50.9	30.6	21.8	46.2
	Highest temperature.....	50	50	61	82	92	97	102	100	101	90	70	48	102
	Lowest temperature.....	-15	-9	-5	27	41	42	58	55	47	29	-6	-8	-15
	Precipitation.....	0.90	0.92	0.99	2.69	1.50	4.33	3.33	1.41	1.60	4.68	0.52	1.07	23.94
	Rainy days.....	4	7	2	7	7	9	4	5	6	7	6	5	69
	No. cloudless days.....	15	11	11	11	17	9	20	16	21	14	12	13	170
	No. partly cloudy days....	3	11	10	9	12	15	9	11	7	11	8	5	111
	No. cloudy days	13	6	10	10	2	6	2	4	2	6	10	13	84
	Prevailing direction wind	NW	NW	NW	NW	NW	SE	SE	NE	S	NW	NW	NW	NW
Lexington....	Mean temperature.....	25.6	29.8	36.1	46.2	60.1	67.6	73.1	70.4	67.7	53.3	34.0	22.8	48.9
	Highest temperature.....	66	56	74	83	87	92	102	96	97	90	75	54	102
	Lowest temperature.....	-14	-6	2	17	23	37	47	43	39	18	-3	-15	-15
	Precipitation.....	0.20	0 81	1.59	4.24	0.30	4 61	0.72	1.57	1.60	4.13	0.72	1.30	21.79
	No. rainy days.....	3	5	6	6	4	11	7	6	5	6	2	3	64
	No. cloudless days	13	6	11	12	13	6	24	15	20	13	13	13	164
	No. partly cloudy days....	6	13	12	7	8	13	4	9	6	8	12	8	106
	No. cloudy days.....	12	9	8	11	5	11	3	7	4	10	5	10	95
	Prevailing direction wind	NW	SW	SE	NW	NW	SE	SE	NE	S	SE	SE	NW	NW
Lincoln.....	Mean temperature.....	22.6	26.9	35 6	50.0	60.8	71.9	78.2	71.7	74.8	58.9	37.2	22.6	50.9
	Highest temperature..... ..	51	61	69	80	88	101	100	96	100	91	73	53	100
	Lowest temperature.....	-10	-9	-5	30	34	44	53	48	44	33	0	-18	-18
	Precipitation.....	0.65	0.90	1.48	6.15	2.22	2.17	2.54	2.69	1.71	2.77	0.29	2.10	25.67
	No. rainy days.....	7	8	10	13	11	11	6	7	4	7	4	8	96
	No. cloudless days.....	15	5	6	9	10	3	15	16	20	17	11	8	135
	No. partly cloudy days....	5	15	14	11	10	25	16	10	9	7	11	12	164
	No. cloudy days.....	11	8	11	10	2	2	0	5	1	7	8	11	76
	Prevailing direction wind	NW	NE	SE	NW	SE	NE	SE	NE	S	SE	N	NW	SE
	Mean velocity.....	12.2	9.3	12.8	14.7	10.2	10.8	10.6	8.7	9.9	11.2	11.1	10.4	11.0
	Highest velocity.....	46	38	44	50	38	55	42	48	34	38	40	40	55
	Mean relative humidity ...	82.8	83.6	80.3	80.2	71.5	65.8	65.1	73.0	60.6	67.2	70.4	75.6	73.1
	Lowest relative humidity	60	68	51	43	47	35	39	43	28	31	38	49	28
Lodge Pole...	Mean temperature.....	23.0	27.8	34.8	46.3	60.6	66.3	71.7	68.5	65.8	48.2	36.2	23.2	47.7
	Highest temperature.....	64	55	79	89	93	99	104	98	95	86	84	59	104

Digitized by Google

METEOROLOGICAL DATA—*Continued*

STATION.	DATA.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Lodge Pole..	Lowest temperature.....	-22	-4	-2	13	24	35	38	42	32	19	-6	-18	-22
	Precipitation	0.15	0.40	2.25	2.10	3.38	1.42	2.15	3.61	T	1.50	0.20	0.60	17.76
	No. rainy days.....	2	2	4	3	4	8	4	5	0	1	2	3	38
	No. cloudless days.....	21	18	21	23	21	15	26	19	23	23	.....	20	.....
	No. partly cloudy days...	6	8	4	4	8	14	3	12	6	4	.....	8	.....
	No. cloudy days.....	4	2	6	3	2	1	2	0	1	4	.....	3	.....
	Prevailing direction wind	W	W	.....	W	SE	E	.....	E	.....	W	.....	W	W
Loup.....	Mean temperature.....	23.2	27.3	34.3	47.9	59.5	67.7	73.6	69.3	70.9	52.2	34.8	24.6	48.8
	Highest temperature.....	62	54	70	88	88	98	102	96	98	88	80	60	102
	Lowest temperature.....	-12	-4	0	20	28	40	50	44	38	28	-6	-8	-12
	Precipitation.....	0.42	0.43	1.32	4.80	0.65	7.17	0.78	7.75	2.97	5.75	0.25	1.35	33.64
	No. rainy days.....	3	5	8	11	5	15	6	6	4	4	2	2	71
	No. cloudless days.....	14	7	12	13	21	15	26	24	22	20	16	16	206
	No. partly cloudy days....	6	16	13	9	10	12	4	3	7	3	11	8	102
	No. cloudy days.....	11	5	6	8	0	3	1	4	1	8	3	7	57
	Prevailing direction wind.	NW	NW	SE	NW	SE	SE	SE	E	S	NW	NW	NW	NW
Lynch	Mean temperature.....	14.7	22.5	29.1	47.8	59.4	68.7	74.5	69.4	72.2	52.8	30.5	22.7	47.0
	Highest temperature.....	50	52	62	87	91	98	99	95	102	90	76	48	102
	Lowest temperature.....	-18	-17	-6	26	33	44	50	46	34	28	-15	-12	-18
	Precipitation.....	0.74	0.48	1.73	5.90	1.34	3.09	3.51	1.31	2.25	2.58	0.57	1.10	24.60
	No. rainy days.....	7	6	7	10	4	8	9	7	4	8	6	8	84
	No. cloudless days	15	10	14	14	21	15	26	23	26	16	11	15	206
	No. partly cloudy days....	3	18	4	3	7	10	3	4	2	6	18	4	62
	No. cloudy days.....	13	10	13	13	3	5	2	4	2	9	11	12	97
	Prevailing direction wind.	NW	NW	NW	NW	NW	NW	NW	NW	S	NW	NW	NW	NW
Lyons.....	Precipitation.	1.17	0.84	1.31	4.43	1.21	4.28	1.05	2.51	0 11	2.84	0.25	2.35	22.35
Madison	Mean temperature.....	19.0	25.3	28.9	45.2	56.8	66.9	73.8	67.5	69.4	54.4	30.4	20.8	46.5
	Highest temperature.....	46	55	60	82	85	98	97	95	94	85	68	47	97
	Lowest temperature.....	-12	-13	-6	25	28	38	50	38	38	30	-9	-9	-13
	Precipitation	0.43	0.61	1.53	3.85	1.25	3.51	3.33	3.26	1.40	3.16	0.35	2.35	25.03
	No. rainy days.....	4	5	6	9	2	10	5	7	1	5	3	8	65
	No. cloudless days.....	14	12	11	13	24	16	28	24	24	20	20	13	219
	No. partly cloudy days...	5	8	11	9	6	11	3	4	4	5	3	8	77
	Cloudy days.....	12	8	9	8	1	3	0	3	2	6	7	10	69

Digitized by Google

METEOROLOGICAL DATA—*Continued.*

STATION.	DATA.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Madison.....	Prevailing direction wind.	NW	SE	SE	NW	SW	SE	SW	SE	SW	NW	NW	NW	NW
Madrid	Mean temperature.....	24.2	29.6	34.6	47.8	61.6	71.6	76.6	72.3	70.8	49.2	36.4	20.4	49.2
	Highest temperature.....	55	55	70	85	90	98	108	103	101	90	78	50	108
	Lowest temperature.....	-10	5	5	18	35	40	55	45	35	22	5	-12	-12
	Precipitation.....	T	0.20	1.36	2.19	0.88	1.52	1.30	2.19	0.22	2.63	T	0.95	13.44
	No. rainy days.....	0	1	6	5	4	*7	2	8	1	3	0	5	42
	No. cloudless days.....	12	6	8	9	9	0	14	9	22	14	6	8	117
	No. partly cloudy days....	8	15	12	14	17	18	11	14	5	7	13	14	145
	No. cloudy days.....	11	7	11	7	5	12	6	8	3	10	11	9	100
	Prevailing direction wind.	NW	NW	SE	NW	SE	NW	SE	SE	S	NW	NW	NW	NW
Marquette....	Precipitation	1.53	0.77	1.93	4.48	2.48	3.40	1.82	1.72	1.83	4.79	0.75	1.45	26.95
McCook.....	Mean temperature.....	23.8	30.0	36.8	48.8	65.8	72.4	79.0	73.7	74.6	56.2	36.6	.....	.....
	Highest temperature.....	63	62	82	87	88	98	101	100	100	87	67	.....	101
	Lowest temperature.....	-16	4	10	32	46	46	58	58	48	30	0	.....	-16
	Precipitation	T	1.00	0.85	3.27	0.11	5.63	0.81	1.81	1.04	4.65	0.55	1.00	20.72
	No. rainy days.....	0	3	3	6	1	10	3	6	3	5	3	3	46
	No. cloudless days.....	15	8	16	17	9	10	21	17	26	23	16	11	189
	No. partly cloudy days....	6	9	3	5	13	2	7	11	1	0	7	12	76
	No. cloudy days.....	10	10	12	8	9	18	3	3	3	8	7	8	99
	Prevailing direction wind.	NW	SW	SW	N	SE	SE	SE	SE	SW	SW	NW	NW	SW
McCool Junc.	Precipitation.....	.....	0.49	3.12	5.35	2.25	2.92	1.84	1.61	1.90	5.71	.....	1.20	.....
Minden.....	Mean temperature.....	23.7	27.9	35.3	48.4	60.8	69.7	74.4	71.4	72.4	54.8	34.6	23.1	49.7
	Highest temperature.....	54	64	71	84	91	95	102	98	102	92	73	55	102
	Lowest temperature.....	-12	-8	6	30	34	48	48	43	40	28	-8	-17	-17
	Precipitation.....	0.80	1.25	1.93	4.48	2.11	4.99	3.05	2.27	1.04	7.34	0.97	1.61	31.84
	No. rainy days.....	6	8	10	11	7	15	8	7	4	6	14	8	94
	No. cloudless days.....	12	7	13	10	15	4	17	11	20	15	4	9	147
	No. partly cloudy days....	8	9	8	8	10	22	12	11	6	11	9	13	127
	No. cloudy days.....	11	12	10	12	6	4	2	9	4	5	7	9	91
	Prevailing direction wind	NW	S	SE	NW	SE	SE	SE	SE	S	SE	S	N	SE
Nebraska C'y	Mean temperature.....	23.8	27.2	33.5	50.4	60.6	73.4	77.9	71.8	74.4	61.6	38.5	20.2	51.8
	Highest temperature.....	52	62	70	80	85	94	102	100	101	91	75	50	102

Digitized by Google

METEOROLOGICAL DATA.—*Continued.*

STATION.	DATA.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Nebraska C'y	Lowest temperature	-8	-12	-6	28	36	45	53	37	38	34	0	-14	-14
	Precipitation	0.50	0.55	1.75	3.69	3.67	2.79	3.64	2.36	1.58	2.76	0.95	1.30	24.64
	No. rainy days	2	3	7	11	12	9	4	8	4	6	2	4	64
	No. cloudless days	18	9	9	18	19	15	30	23	30	25	23	24	239
	No. partly cloudy days	2	2	10	4	11	9	1	4	0	2	4	3	54
	No. cloudy days	11	17	12	13	1	6	0	4	0	4	3	4	72
	Prevailing direction wind	N	S	N	SE	SW	S	.....	NE	SW	SE	SW	N	S
Nemaha	Mean temperature	21.8	27 1	35.6	49.6	62.8	74.7	79.9	72.6	70.0	56.4	23.7	20.7	50.4
	Highest temperature	58	49	68	83	95	104	102	108	102	94	72	53	108
	Lowest temperature	-8	-7	-8	32	41	50	59	46	42	30	-2	-14	-14
	Precipitation	0.58	0 96	1.75	4.88	2.92	3 71	2.25	2.76	3.22	2.55	0.50	2.00	27.58
	No. rainy days	4	5	6	7	6	9	6	5	3	4	2	3	60
	No. cloudless days	10	3	6	8	6	1	11	9	20	18	1	1	94
	No. partly cloudy days	7	12	13	10	23	26	19	13	8	7	13	10	161
	No. cloudy days	14	13	12	12	2	3	1	9	2	6	16	20	110
	Prevailing direction wind	NW	NW	NW	NE	SE	SE	SE	NE	NW	NW	NE	NW	NW
Nesbit	Mean temperature	29.8	27.1	34.0	45.5	59.8	67.1	74.8	70.4	69.1	50.4	34.5	22.1	48.71
	Highest temperature	71	50	64	84	91	94	104	100	97	87	77	50	104
	Lowest temperature	0	1	-3	22	25	40	50	45	38	24	-6	-11	-11
	Precipitation	0.50	0.35	0.47	2.84	0.27	3.47	2.39	1.99	1.57	6.49	0.80	0.59	21.73
	No. rainy days	1	1	4	8	5	13	3	11	4	4	1	2	57
	No. cloudless days	9	11	10	10	13	4	17	12	24	16	15	15	156
	No. partly cloudy days	14	9	7	10	13	21	9	14	0	6	6	11	120
	No. cloudy days	8	8	14	10	5	5	5	5	6	9	9	5	89
	Prevailing direction wind	NW	NW	NW	NW	SE	SE	SE	NW	SE	NW	NW	SW	NW
Norfolk	Mean temperature	16.8	23.0	27.1	44.0	60.2	68.8	75.3	70.6	71.0	55.0	33.8	19.9	47.1
	Highest temperature	43	44	59	75	85	92	96	96	94	85	70	49	96
	Lowest temperature	-16	-20	-2	22	32	42	51	45	38	30	-6	-10	-20
	Precipitation	0.70	0.43	1.55	3.86	1.03	2.98	3.72	2.67	1.53	2.97	0.26	2.10	23.65
	No. rainy days	4	5	6	10	3	12	5	9	4	6	4	4	69
	No. cloudless days	13	9	11	12	16	6	22	22	27	18	17	15	184
	No. partly cloudy days	2	5	1	1	5	4	1	3	0	1	3	1	25
	No. cloudy days	16	14	19	17	10	20	8	6	3	12	10	15	156
	Prevailing direction wind	NW	NW	NW	NW	NW	SE	SE	N	S	SE	NW	NW	NW
Norman	Precipitation	0.45	1.18	0.99	5.08	1.96	5.88	2.18	4.55	1.72	6.73	0.89	.....	.....

Digitized by Google

METEOROLOGICAL DATA—*Continued.*

STATION.	DATA.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
North Loup..	Mean temperature.....	22.2	28.6	34.3	47.4	60.4	69.8	74.9	69.4	69.8	51.6	33.5	22.6	48.7
	Highest temperature.....	55	56	66	79	90	96	99	98	97	87	76	52	99
	Lowest temperature.....	-11	-6	-7	27	28	39	49	43	36	28	-10	-8	-11
	Precipitation	0.80	0.36	1.42	6.05	0.72	7.87	1.19	2.54	1.00	4.65	0.28	1.40	28 23
	No. Rainy days.....	3	6	8	13	5	14	8	9	5	7	2	3	83
North Platte.	Mean temperature.....	25.2	29.6	35.6	47.8	60.4	66.6	74.5	70.2	70.8	53.1	36 4	25.2	49.6
	Highest temperature.....	58	58	68	82	87	94	103	95	94	90	79	56	103
	Lowest temperature.....	-7	3	5	26	28	43	51	47	42	25	1	-9	-9
	Precipitation.....	0.47	0.46	0.67	2.59	0.11	1.72	1.85	3.05	0.59	4.11	0.85	0.63	17.09
	No. rainy days.....	4	4	9	10	4	12	10	10	7	7	4	7	88
	No. cloudless days.....	15	4	11	8	14	4	14	11	20	12	18	17	143
	No. partly cloudy days....	10	19	9	15	17	21	15	17	7	13	14	8	165
	No. cloudy days.....	6	5	11	7	0	5	2	3	3	6	3	6	57
	Prevailing direction wind	W	NW	SE	NW	SE	SE	NW	W	S	NW	W	W	NW
	Mean velocity.....	10.2	7.6	10.5	11.6	9.9	9.8	8.8	7.3	9.9	9.7	8.0	8.8	9.2
	Highest velocity.....	46	32	40	40	46	32	48	26	41	51	33	35	51
	Mean relative humidity...	74.6	75.4	74.4	70.1	60.8	72.0	62.0	68.5	64.0	68.9	73.1	72.6	69.7
	Lowest relative humidity.	45	41	28	26	29	23	23	29	28	.....	44	40	23
Oakdale.....	Mean temperature.....	16.8	23.7	29.8	47.0	59.0	67.8	74.2	67.6	70.6	52.0	31.2	19.8	46.6
	Highest temperature.....	47	50	60	80	90	95	103	95	96	88	78	49	103
	Lowest temperature.....	-14	-13	-8	24	30	39	50	41	36	27	-1?	-10	-14
	Precipitation	1.61	0.51	1.78	3.36	1.12	4.87	2.98	3.38	1.15	2.33	0.64	1.44	25.17
	Rainy days.....	7	6	8	8	6	11	3	7	5	8	4	10	83
	No. cloudless days.....	12	7	8	8	15	7	17	11	19	8	9	9	130
	No. partly cloudy days ...	9	13	13	11	12	19	13	14	8	13	11	9	145
	No. cloudy days.....	10	8	10	11	4	4	1	6	3	10	10	13	90
	Prevailing direction wind	NW	NW	NW	NW	NW	SE	S	S	S	S	NW	NW	NW
Odell.....	Mean temperature.....	25.0	30.8	40.2	52.6	65.1	73 3	81.1	74.0	73.6	56.8	37.2	24.0	52.8
	Highest temperature	54	58	70	80	90	94	97	96	96	89	68	56	97
	Lowest temperature.....	-8	-4	12	32	46	52	62	58	46	28	-1	-18	-18
	Precipitation	0.44	0.42	2.36	4.33	2.43	4.82	5.35	2.83	4.00	4.61	0.15	1.30	33.04
	No. rainy days.....	4	3	5	7	5	10	4	5	2	5	1	3	54
	No. cloudless days.....	12	2	9	9	12	9	24	26	28	22	18	13	179
	No. partly cloudy days...	8	14	9	9	15	18	3	2	7	4	4	11	104
	No. cloudy days.....	11	12	13	12	4	3	4	3	0	5	8	7	82

Digitized by Google

METEOROLOGICAL DATA—*Continued.*

STATION.	DATA.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Odell	Prevailing direction wind	NW	NW	NW	NW	S	S	S	S	S	S	S	NW	S
Omaha	Mean temperature	20.9	27.2	34.6	50.5	61.8	72.2	78.8	71.8	75.2	59.2	36.5	21.8	50.9
	Highest temperature	51	59	66	79	87	98	102	95	99	91	71	47	102
	Lowest temperature	-13	-11	-3	29	38	47	57	51	45	35	-2	-12	-13
	Precipitation	0.87	0.63	1.47	5.67	2.16	1.43	2.01	1.92	1.39	1.82	0.14	1.79	21.30
	No. rainy days	9	6	12	14	11	11	9	6	4	7	6	12	107
	No. cloudless days	13	4	5	9	16	6	16	15	21	15	12	9	141
	No. partly cloudy days	7	12	12	9	11	17	14	11	8	10	11	7	129
	No. cloudy days	11	12	14	12	4	7	1	5	1	6	7	15	95
	Prevailing direction wind	NW	NW	SE	NW	SE	SE	SE	N	S	SE	N	NW	SE
	Mean velocity	8.7	7.7	9.5	10.4	7.5	8.6	7.7	6.8	7.2	7.8	8.1	7.6	8.2
	Highest velocity	29	24	38	35	26	29	43	34	29	26	31	25	43
	Mean relative humidity	84.8	82.0	83.3	76.6	61.0	66.1	65.0	68.9	57.8	64.8	85.8	83.5	71.6
	Lowest relative humidity	50	61	46	35	25	34	26	34	24	22	34	60	22
O'Neill	Mean temperature	17.4	24.2	28.5	45.6	57.9	66.8	73.0	67.2	69.5	50.6	31.5	19.6	46.0
	Highest temperature	54	59	65	81	84	93	100	95	97	87	77	47	100
	Lowest temperature	-15	-16	-6	28	28	38	48	41	37	25	-13	-10	-16
	Precipitation	1.31	0.45	1.69	4.85	1.35	3.15	1.51	2.26	3.10	3.84	0.13	1.86	25.53
	No. rainy days	4	4	6	12	6	8	5	5	3	7	2	5	67
	No. cloudless days	17	10	13	13	17	7	15	16	15	11	6	10	150
	No. partly cloudy days	2	8	10	8	11	20	15	11	12	14	13	12	136
	No. cloudy days	12	10	8	9	3	3	1	4	3	6	11	9	79
	Prevailing direction wind	NW	NW	NW	NW	NW	NW	NW	NW	SE	NW	NW	NW	NW
Ord	Precipitation	0.41	0.42	1.57	4.63	1.05	4.90	1.71	3.33	0.96	4.36	0.10	0.87	24.31
Osceola	Precipitation	0.60	0.60	2.37	6.74	2.94	2.50	1.29	2.29	0.77	5.30	0.37	1.50	27.27
Ough	Precipitation	0.20	T	2.19	2.85	0.68	2.76	1.80	5.78	0.63	3.77	0.33	0.50	20.99
Palmer	Mean temperature						65							
	Highest temperature		32	50	62	70	80	88	87	75		44		
	Lowest temperature				32		50	59	55	44				
	Precipitation	1.10	0.50	3.17	4.44	2.30	4.84	2.06	3.49	2.69	4.68	0.08		
	No. rainy days	5	2	7	12	5	14	4	8	6	6	1		
	No. cloudless days	15	11	13	7	19	5	24	18	22	21	18		

Digitized by Google

METEOROLOGICAL DATA—*Continued.*

STATION.	DATA.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Palmer	No. partly cloudy days	5	14	11	17	11	18	4	7	7	6	11	.....	.....
	No. cloudy days	11	8	1	6	1	7	3	6	1	4	1	.....	.....
	Prevailing direction wind	N	S	N	N	S	E	SE	S	S	N	N	.....	.....
Ravenna	Mean temperature	24.4	28.4	35.4	49.0	59.6	68.2	75.8	70.6	71.5	55.0	35.6	23.6	49.8
	Highest temperature	63	57	72	79	89	95	101	98	97	88	82	55	101
	Lowest temperature	-10	-4	-4	27	26	40	50	44	39	29	-5	-10	-10
	Precipitation	0.60	0.88	1.61	5.21	1.94	5.82	1.73	6.54	1 63	4.96	0.30	1.53	32.75
	Rainy days	6	8	7	10	5	16	7	8	6	5	3	11	92
	No. cloudless days	17	7	12	10	20	11	24	21	22	19	18	13	194
	No. partly cloudy days	4	13	10	12	10	14	6	5	5	7	7	11	104
	No. cloudy days	10	8	9	8	1	5	1	5	3	5	5	7	67
	Prevailing direction wind	NW	S	N	SE	S	S	S	N	S	S	N	NW	S
Red Cloud	Mean temperature	24.2	31.9	37.6	52.2	64.6	76 3	80.7	71.6	72.1	.....	40.4	25.6	.....
	Highest temperature	48	54	76	82	87	96	100	90	90	.....	70	54	100
	Lowest temperature	-7	-4	10	30	46	50	64	54	50	.....	2	-10	-10
	Precipitation	0.93	0.36	1.73	4.50	2.65	12.25	3.92	0.99	1.44	5.21	0.60	1.00	32.85
	Rainy days	4	3	6	7	4	11	4	5	4	4	2	3	56
	No. cloudless days	16	7	17	11	15	10	20	.....	27	.....	22	18	.....
	No. partly cloudy days	6	18	8	14	15	13	8	.....	0	.....	1	7	.....
	No. cloudy days	9	3	6	5	1	7	3	.....	3	.....	7	6	.....
	Prevailing direction wind	N	SW	NE	NE	SE	SW	SW	.....	SE	.....	N	N	SE
Republican	Mean temperature	25.2	31.3	37.0	51.3	64.6	77.0	82.5	72.6	67.3	54.7	35.5	24.2	51.9
	Highest temperature	57	63	78	86	88	98	102	98	100	92	72	60	102
	Lowest temperature	-14	1	11	34	38	50	68	54	44	32	0	-14	-14
	Precipitation	0.40	0.60	0.70	4.04	1.40	3 56	2.21	6.41	1.23	3.76	0.30	0.95	25.47
	No. rainy days	1	3	2	6	3	6	5	5	2	4	2	3	43
	No. cloudless days	16	8	20	16	.....	.....	25	.....	21	.....	19	14	.....
	No. partly cloudy days	8	12	6	3	.....	.....	3	.....	6	.....	6	5	.....
	No. cloudy days	7	7	5	11	.....	.....	3	.....	3	.....	5	12	.....
	Prevailing direction wind	NW	N	NW	SE	.....	.....	SW	.....	S	.....	NW	NW	.....
Rulo	Mean temperature	26.6	34.1	41.7	54.5	65.0	77.2	82.6	74.6	75.6	61.1	41.4	26.5	55.1
	Highest temperature	54	54	68	84	88	94	102	100	98	98	80	54	102
	Lowest temperature	-4	-2	4	37	48	52	66	58	50	34	6	0	-4
	Precipitation	0.70	0.90	2.50	5.12	4.30	3.93	2.53	5.23	0.90	2.10	0.30	1.15	29.66

Digitized by Google

METEOROLOGICAL DATA—*Continued.*

STATION.	DATA.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Rulo	No. rainy days	4	4	5	7	7	9	4	6	2	5	1	3	57
	No. cloudless days	10	3	10	15	19	12	19	21	25	20	18	16	188
	No. partly cloudy days	7	13	6	2	3	11	9	6	4	1	2	4	68
	No. cloudy days	14	12	15	13	9	7	3	4	1	10	10	11	109
	Prevailing direction wind	NW	N	E	W	W	SE	SE	.....	NW	N	NW	NW	NW
St. Libory	Precipitation	1.11	0.80	1.87	4.34	1.00	4.94	2.60	3.04	3.07	5.14	0.23	1.90	30.04
St. Paul	Mean temperature	25.1	30.6	37.0	50.8	62.6	72.0	78.6	73.2	73.4	56.1	37.0	25.8	51.8
	Highest temperature	55	56	68	80	88	95	101	96	97	88	71	52	101
	Lowest temperature	−8	−4	6	30	32	42	56	50	42	31	−3	−10	−10
	Precipitation	0.96	0.72	1.89	4.59	0.50	5.06	1.75	3.23	1.41	5.35	0.17	1.20	26.83
	No. rainy days	5	5	7	11	4	14	7	8	3	6	3	5	78
	No. cloudless days	17	22	20	16	27	19	27	22	25	20	22	15	252
	No. partly cloudy days	1	1	3	6	2	8	4	7	4	5	3	8	52
	No. cloudy days	13	5	8	8	2	3	0	2	1	6	5	8	61
	Prevailing direction wind	NW	SW	SE	NW	NW	SW	S	SE	S	NW	SW	SW	SW
Salem	Mean temperature	27.0	30.8	41.3	50.4	62.9	75.6	82.2	75.3	71.8	61.6	42.2	28.2	53.7
	Highest temperature	52	48	70	66	82	96	100	104	98	92	80	62	104
	Lowest temperature	−4	2	2	32	44	48	60	52	44	36	6	−8	−8
	Precipitation	0.42	0.70	2.41	3.82	5.80	1.20	2.30	4.10	1.10	1.50	0.15	1.45	24.45
	No. rainy days	4	5	7	6	3	5	4	4	3	5	2	4	52
	No. cloudless days	9	3	9	10	14	2	16	18	24	7	7	3	.....
	No. partly cloudy days	6	.....	3	3	6	24	10	11	5	15	11	12	.....
	No. cloudy days	16	.....	19	17	10	4	5	4	1	9	12	16	.....
	Prevailing direction wind	NW	.....	N	N	.....	S	SE	S	S	SE	NW	NW	NW
Santee Ag'cy	Mean temperature	14.9	22.0	28.0	47.8	61.5	69.1	77.6	71.4	74.5	54.6	33.2	21.2	48.0
	Highest temperature	50	45	60	85	89	100	104	101	102	92	75	50	104
	Lowest temperature	−20	−16	−8	24	31	40	51	45	37	31	−3	−10	−20
	Precipitation	1.37	0.44	1.33	4.32	0.86	2.19	2.71	1.28	1.66	2.09	0.52	1.43	20.20
	Rainy days	5	6	7	12	6	10	5	7	2	8	5	7	80
	No. cloudless days	15	2	8	8	16	2	15	11	20	12	11	8	129
	No. partly cloudy days	6	22	18	16	14	24	15	14	8	10	14	12	173
	No. cloudy days	10	4	5	6	1	4	1	6	2	8	5	11	63
	Prevailing direction wind	NW	NW	NW	NW	SW	SE	NE	NE	S	SW	SW	SW	NW

Digitized by Google

METEOROLOGICAL DATA—*Continued.*

Station.	Data.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Sargent	Precipitation	0.74	0.72	0.97	3.77	0.81	5.13	2.19	3.03	0.57	5.25	0.12	1.39	24.69
Schuyler	Precipitation	0.90	0.70	1.21	6.25	0.69	3.24	1.36	4.20	0.60	3.64	0.20	2.30	25.29
Seneca	Mean temperature	23.0	30.4	34.6	46.4	63.8	70.0	73.6	68.0	69.8	.....	35.0	26.8	.....
	Highest temperature	60	55	70	87	90	96	99	94	94	.....	62	56	99
	Lowest temperature	-12	-2	3	27	40	45	50	44	38	.....	0	-6	-12
	Precipitation	0.55	0.40	1.59	3.93	0.50	5.70	4.54	1.80	0.89	0.70	T	1.20	21.80
	No. rainy days	4	1	3	7	2	12	6	4	3	2	0	3	47
	No. cloudless days	14	7	11	10	12	9	22	6	9	0	5	10	115
	No. partly cloudy days	0	8	2	10	19	13	5	20	18	13	10	10	128
	No. cloudy days	17	13	18	10	0	8	4	5	3	18	15	11	122
	Prevailing direction wind	NW	.....	NW	NW	NW	SE	SE	NW	S	NW	NW	NW	NW
Seward	Mean temperature	22.4	28.5	35.6	49.9	60.4	74.4	77.8	71.6	70.1	57.6	36.2	22.6	50.6
	Highest temperature	47	60	64	76	90	94	99	94	98	88	72	53	99
	Lowest temperature	-7	-9	3	33	45	48	58	53	47	36	0	-15	-15
	Precipitation	0.80	0.60	3.34	7.31	5.23	1.28	2.32	2.05	0.99	3.57	0.30	1.20	28.99
	No. rainy days	1	2	4	12	8	8	2	6	4	4	1	3	55
	No. cloudless days	15	15	13	11	13	14	26	19	24	15	15	15	197
	No. partly cloudy days	4	4	3	3	14	12	3	5	5	5	9	3	70
	No. cloudy days	12	9	15	16	2	4	2	7	1	11	6	13	98
	Prevailing direction wind	NW	NW	NW	S	SW	SW	SW	NW	SW	SW	NW	NW	NW
Springfield	Mean temperature	18.1	26.6	34.1	49.1	60.8	72.6	78.4	71.2	.....	57.4	.....	.....	.....
	Highest temperature	48	16	67	80	88	98	101	93	.....	92	.....	.....	.....
	Lowest temperature	-15	-11	-6	29	38	48	54	49	.....	30	.....	.....	.....
	Precipitation	0.74	0.53	1.57	6.78	2.81	1.55	3.79	2.16	.....	3.05	.....	.....	.....
	Rainy days	6	4	13	14	8	9	7	7	.....	6	.....	.....	.....
	No. cloudless days	9	7	8	10	14	7	17	16	.....	16	.....	.....	.....
	No. partly cloudy days	8	8	9	8	9	14	13	9	.....	6	.....	.....	.....
	No. cloudy days	14	13	14	12	8	8	1	6	.....	9	.....	.....	.....
	Prevailing direction wind	NW	NW	SE	NW	SE	SE	SE	NW	.....	SE	.....	.....	.....
Springview	Mean temperature	17.9	.....	33.8	45.8	62.2	68.2	76.6	71.0	72.3	50.6	31.5	21.9	.....
	Highest temperature	56	44	66	88	93	100	106	99	98	87	72	50	106
	Lowest temperature	-15	-11	-8	25	30	40	53	46	40	27	-11	-11	-17
	Precipitation	1.15	0.39	0.50	1.31	2.11	1.90	1.12	2.14	2.01	2.75	0.30	.....	.....

Digitized by Google

METEOROLOGICAL DATA—*Continued*

STATION.	DATA.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Springview....	No. rainy days.....	2	3	1	3	3	6	5	4	6	4	1	.....	.....
	No. cloudless days	15	.....	13	6	17	11	19	19	23	14	11	12	.....
	No. partly cloudy days....	3	.....	11	13	13	14	10	9	5	10	12	13	.....
	No. cloudy days.....	13	.....	7	11	1	5	2	3	2	7	7	6	.....
	Prevailing direction wind.	NW	NW	NW	NW	NW	NW	NW	NW	S	S	N	W	NW
Stanton.....	Mean temperature.....	17.4	24.8	31.0	48.4	61.6	70.6	75.7	68.7	70.6	53.8	32.2	20.6	47.5
	Highest temperature.....	45	50	59	80	85	98	101	94	97	90	76	49	101
	Lowest temperature.....	-15	-14	-1	27	36	46	56	38	43	30	-11	-9	-15
	Precipitation.....	0.61	0.20	1.52	4.92	1.27	4.93	2.19	1.97	1.13	3.29	0.39	2.40	25.11
	Rainy days.....	4	2	5	10	4	12	7	6	2	5	2	3	62
	No. cloudless days.....	19	21	17	18	26	22	28	25	27	24	23	21	271
	No. partly cloudy days....	7	5	9	5	3	8	3	3	3	2	3	3	54
	No. cloudy days.....	5	2	5	7	2	0	0	3	0	5	4	7	40
	Prevailing direction wind	NW	NW	NW	N	NW	SE	SE	N	S	S	NW	NW	NW
Strang.....	Mean temperature.....	25.3	28.8	37.4	52.4	64.4	75.8	82.2	75.4	76.6	57.4	35.6	25.8	53.1
	Highest temperature.....	58	64	70	84	90	98	102	98	100	90	70	54	102
	Lowest temperature.....	-7	-8	3	34	44	52	62	56	48	30	2	-16	-16
	Precipitation.....	0.60	0.90	1.63	5.27	3.39	2.84	2.99	4.60	1.56	5.40	0.25	1.10	30.53
	No. rainy days.....	1	3	5	8	8	9	3	2	4	4	1	5	53
	No. cloudless days.....	6	3	4	8	9	.....	13	9	17	10	8	7	94
	No. partly cloudy days.....	9	8	10	5	18	23	17	12	10	15	12	7	146
	No. cloudy days.	16	17	17	17	4	7	1	10	3	6	10	17	125
	Prevailing direction wind.	NW	NW	NW	SE	S	SE	S	SE	S	NW	N	NW	NW
Stratton.....	Precipitation	0.59	0.52	2.22	2.50	0.45	3.29	1.45	2.97	0.90	4.35	0.24	0.64	20.12
Stromsburg.	Lowest temperature.....	1.91	0.94	1.45	3.56	2.57	3.47	1.51	2.90	0.75	4.94	0.30	.....	.....
Superior.....	Mean temperature.....	20.9	29.0	38.5	52.0	63.2	72.6	81.3	74.7	74.2	57.8	35.6	23.8	52.0
	Highest temperature.....	50	62	72	80	87	95	106	98	96	90	70	54	106
	Lowest temperature.....	-7	-4	8	32	40	48	58	58	46	30	0	-11	-11
	Precipitation.....	0.35	0.25	1.30	5.64	1.71	8.39	3.90	1.39	2.08	4.87	0.75	1.10	31.63
	No. rainy days.....	2	2	7	11	6	16	5	3	4	4	1	5	66
	No. cloudless days.....	14	8	14	14	16	12	22	18	23	16	12	11	179
	No. partly cloudy days....	9	2	1	6	9	13	6	7	4	9	11	0	77
	No. cloudy days.....	8	18	17	10	6	5	3	6	3	6	7	20	109
	Prevailing direction wind	NW	SE	NW	NW	SE	SE	SE	NW	SE	E	N	NW	NW

Digitized by Google

METEOROLOGICAL DATA—*Continued.*

Station.	Data.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Sutton.....	Mean temperature.....	23.2	27.5	32.6	49.0	.....	.....	75.1	.....	.....	53 8	32.9	.....	.....
	Highest temperature.....	53	64	72	78	.....	.....	98	.....	.....	88	69	.....	.....
	Lowest temperature.....	-10	-7	-3	30	.....	.....	51	.....	.....	32	-5	.....	.....
	Precipitation.....	1.97	1.59	3.18	6.21	2.12	3.70	3.23	2.85	2.25	3.33	0.47	.....	.....
	No. rainy days.....	5	6	9	13	7	12	7	10	6	7	3	.....	.....
	No. cloudless days.....	7	3	4	7	5	3	14	10	13	8	4	.....	.....
	No. partly cloudy days....	7	17	17	15	19	19	14	17	11	14	16	.....	.....
	No. cloudy days.....	17	8	10	8	7	8	3	4	6	9	10	.....	.....
	Prevailing direction wind.	NW	N	N	N	S	S	SW	S	S	S	SW	.....	.....
Syracuse.....	Precipitation.....	0,76	0.04	1.15	3.42	2.45	2.18	1.62	1.65	2.77	3.46	0.05	1.65	21.20
Tecumseh	Mean temperature.....	25.2	28.4	38.6	53.4	59.3	72.8	79.4	71.6	71.6	.....	.....	27.4	.....
	Highest temperature.....	53	58	72	83	92	100	103	102	100	.....	.....	60	103
	Lowest temperature.....	-10	6	6	28	31	36	54	45	40	.....	.....	-12	-12
	Precipitation.....	0.65	0.48	2.23	5.32	7 09	3.89	2.90	4.84	0.61	3.49	0.18	0.73	32.41
	No. rainy days.....	6	4	8	14	8	9	5	8	2	5	1	5	75
	No. cloudless days.....	13	10	10	10	15	10	24	17	24	17	17	13	.....
	No. partly cloudy days....	3	4	4	4	5	6	2	4	2	5	10	5	.....
	No. cloudy days.....	14	14	17	16	11	14	5	10	4	9	3	13	.....
	Prevailing direction wind.	.....	NW	SE	NW	SW	SE	SW	SW	SW	NW	NW	N	NW
Tekamah.....	Mean temperature.....	17.6	24.2	34.4	50.1	59.6	70.2	76.8	69.8	71.8	57.6	34.2	19.6	48.8
	Highest temperature.....	48	55	65	80	90	96	102	98	98	93	73	49	102
	Lowest temperature.....	-16	-14	-6	26	33	42	53	42	32	27	-9	-19	-19
	Precipitation	1.50	0.80	1.23	5.09	0.61	4.92	0.88	3.06	0.57	2.01	0.32	2.85	23 84
	No. rainy days.....	5	3	8	12	4	12	6	8	4	6	3	9	80
	No. cloudless days.....	8	7	8	11	15	7	10	9	19	11	14	5	124
	No. partly cloudy days ...	15	17	17	11	15	21	21	16	10	14	8	14	179
	No. cloudy days.....	8	4	6	8	1	2	0	6	1	6	8	12	62
	Prevailing direction wind.	NW	S	N	SE	NW	SE	SE	N	S	S	NW	N	NW
Thedford.....	Mean temperature.....	20.3	26.2	34.9	45.0	62.2	68.1	73.6	69.7	69.1	48.4	32.9	24.6	47.9
	Highest temperature	60	50	68	80	90	98	100	98	98	88	72	58	100
	Lowest temperature.....	-16	-8	-8	28	32	44	54	48	34	24	-10	-12	-16
	Precipitation	0.75	0.55	0.66	3.70	0.90	4 00	4.30	2.90	2.50	3.10	0.45	1.70	25.51
	No. rainy days.....	3	3	4	8	3	10	5	6	3	5	3	6	59
	No. cloudless days.....	17	12	18	16	22	14	22	19	24	21	20	28	228

Digitized by Google

METEOROLOGICAL DATA—*Continued.*

STATION.	DATA.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Thedford	No. partly cloudy days....	7	12	8	6	8	13	6	8	4	5	8	4	89
	No. cloudy days.....	7	4	5	8	1	3	3	4	2	5	2	4	48
	Prevailing direction wind.	NW	NW	NW	NW	NW	NW	NW	NW	NW	NW	NW	NW	NW
Turlington ..	Mean temperature.....	18 3	26.8	35 2	49.6	60.6	71.6	77.5	69.4	70.8	55.3	32.4	16.3	48.6
	Highest temperature.....	48	60	67	80	87	98	103	101	98	88	70	46	103
	Lowest temperature.....	–20	–9	–10	27	34	41	51	47	37	27	–6	–16	–20
	Precipitation.....	0.66	0.40	1.40	4.10	4.01	2.55	2.45	2.60	2.12	3.56	0.11	1.33	25.38
	No. rainy days.....	6	4	8	9	11	12	5	8	4	5	2	4	78
	No. cloudless days.....	15	10	9	10	19	10	22	19	25	19	17	9	184
	No. partly cloudy days....	3	7	10	8	8	13	7	7	4	6	5	9	87
	No. cloudy days.....	13	11	12	12	4	7	2	5	1	6	8	13	94
	Prevailing direction wind	NW	NW	NW	SE	NW	SW	SE	SW	SW	SW	SW	NW	NW
Valentine.....	Mean temperature.....	19.1	24.6	31.1	45.3	59.4	65.6	73.7	69.3	70.2	52.0	33.0	22.1	47.1
	Highest temperature.....	62	49	67	82	88	94	100	100	99	89	78	50	100
	Lowest temperature.....	–20	–8	–5	24	26	40	48	43	36	26	–16	–18	–20
	Precipitation	1.22	1.94	1.50	2.19	3.71	1.69	4.71	2.09	0.67	2.01	0.93	1.03	23.69
	No. rainy days.....	10	11	11	12	9	13	9	8	8	5	12	10	118
	Prevailing direction wind.	.....	NE	NE	NW	S	NE	NW	N	SW	NW	N	W	NW
Wakefield	Mean temperature.....	.....	.....	.....	47.2	58.4	68.4	75.1	68.0	71.8	54.5	33.2	17.2	.....
	Highest temperature.....	.....	.....	.....	78	86	95	100	96	97	89	73	43	100
	Lowest temperature.....	.....	.....	.....	24	31	42	49	42	32	28	–9	–22	–22
	Precipitation	1.73	0.44	1.73	4.26	1.51	4.37	2.89	1.59	0 37	2.98	0.59	3.10	25.56
	No. rainy days.....	6	5	6	11	6	13	4	7	3	6	3	8	78
	No. cloudless days.....	12	13	11	11	17	8	22	20	24	16	16	12	182
	No. partly cloudy days...	7	8	7	7	11	19	9	7	6	7	6	4	98
	No. cloudy days.....	12	7	13	12	3	3	0	4	0	8	8	15	84
	Prevailing direction wind	NW	S	NW	N	S	S	S	S	S	S	S	NW	S
Wallace.....	Precipitation	0.23	0.50	1.35	2.23	T	1.46	0.86	.....	0.12	0.60	0.50	0.70	.....
Weep'gWat'r	Mean temperature.....	18.1	25.5	32.7	47.6	58.2	69.5	75.4	68.0	69.4	54.9	33.4	18.7	47.6
	Highest temperature	49	59	65	80	88	98	102	97	96	86	76	48	102
	Lowest temperature.....	–13	–9	10	26	34	44	48	42	39	30	–7	–25	–25
	Precipitation	1 00	0.46	1.09	3.97	0.45	2.44	1.87	2.95	3.96	3.09	0.21	1.77	23.26
	Rainy days	6	3	10	12	9	8	8	8	5	7	2	7	85

Digitized by Google

METEOROLOGICAL DATA—*Continued.*

STATION.	DATA.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Weep'g Wat'r	No. cloudless days	10	2	5	6	13	2	14	13	18	13	11	6	1 3
	No. partly cloudy days	12	16	15	18	16	26	17	14	9	14	15	18	190
	No. cloudy days	9	10	11	6	2	2	0	4	3	4	4	7	62
	Prevailing direction wind	NW	NW	NW	SW	NE	SE	SW	NE	SW	SW	NW	NW	NW
West Point	Mean temperature	.....	24.1	35.9	49.6	59.6	70.0	76.4	69.3	71.2	57.0	35.4	20.2	.....
	Highest temperature	.....	51	76	78	87	98	100	96	97	89	68	46	100
	Lowest temperature	.....	-15	2	29	32	42	51	39	36	30	-8	-17	.....
	Precipitation	.....	0.54	2.24	6.04	1.47	6.08	2.24	1.86	0.20	3.13	0.20	1 95	.....
	No. rainy days	.....	3	7	16	7	12	7	8	1	6	1	9	.....
	No. cloudless days	.....	.....	14	12	24	17	26	20	26	16	12	9	.....
	No. partly cloudy days	.....	.....	6	11	6	6	5	7	3	7	8	7	.....
	No. cloudy days	.....	.....	11	7	1	7	0	4	1	8	10	15	.....
	Prevailing direction wind	.....	.....	NW	NW	SE	SE	SE	NE	S	S	NW	NW	.....
Whitman	Mean temperature	19.7	23.0	29.6	40.9	57.8	60.2	66.8	65.2	62.0	49.4	34.7	23.9	45.3
	Highest temperature	52	50	70	90	85	100	105	92	82	66	60	50	105
	Lowest temperature	-14	6	0	24	29	37	46	42	44	26	-8	-16	-16
	Precipitation	0.50	0.56	1.05	1.58	1.13	2.60	0.35	0.57	0.05	0.83	1.00	1.70	11.96
	No. rainy days	4	2	3	7	6	5	3	5	1	3	3	3	45
	No. cloudless days	13	2	7	7	13	8	23	12	17	21	15	18	156
	No. partly cloudy days	9	23	14	16	8	12	5	12	8	4	1	0	112
	No. cloudy days	9	3	10	7	10	10	3	7	5	6	14	13	97
	Prevailing direction wind	NW	NW	NE	NW	SE	NW	NE	NE	SW	NE	NW	.....	.....
Wilber	Mean temperature	26.7	30 8	37.5	53.3	65.2	74.5	82.3	72.7	75.5	59.1	39.2	27.0	53.6
	Highest temperature	52	62	70	80	88	96	96	94	94	88	70	56	96
	Lowest temperature	-6	-2	2	38	43	50	66	52	46	30	8	-6	-6
	Precipitation	0.63	0 60	1.52	8.72	1.86	2.48	5.11	3.77	1.38	4.22	T	1.05	31.33
	No. rainy days	4	3	4	10	5	9	6	5	3	6	0	3	58
	No. cloudless days	10	10	12	12	19	13	25	17	24	18	15	11	186
	No. partly cloudy days	4	5	7	9	9	9	3	9	5	6	8	9	83
	No. cloudy days	17	13	12	9	3	8	3	5	1	7	7	11	96
	Prevailing direction wind	NW	NW	S	NW	S	S	S	S	S	S	S	N	S
Willard	Precipitation	0.35	.....	0.45	2.73	0.18	3.65	2.42	1.39	0.78	5.28	0.95	0.10	.....
Wilsonville	Mean temperature	26.6	31.3	.....	45 6	61.3	73.9	18.6	73.8	73.8	57.1	35.4	25.3	.....

Digitized by Google

METEOROLOGICAL DATA.—*Concluded.*

STATION.	DATA.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Wilsonville...	Highest temperature.....	60	66	.....	80	92	100	104	100	100	90	74	56	104
	Lowest temperature.....	-18	-4	.....	28	32	50	62	56	46	28	-7	-19	-19
	Precipitation	0.38	0.45	.....	6.61	1.26	2.97	1.05	4.63	2.70	3.90	0.55	1.30	.....
	No. rainy days.....	3	2	.....	12	4	10	4	6	2	4	3	5	.....
	No. cloudless days.....	10	2	.....	7	3	6	18	7	18	17	9	9	.....
	No. partly cloudy days....	13	19	.....	13	22	18	11	16	8	8	13	11	.....
	No. cloudy days.....	8	7	.....	10	6	6	2	8	4	6	8	11	.....
	Prevailing direction wind.	NW	SW	.....	SW	SE	SW	SW	NE	SE	SW	NW	NW	SW
Wisner.....	Precipitation	1.34	0.43	3.25	4.93	2.82	5.23	1.39	2.18	0.78	3.09	0.23	2.78	28.45
Woodlawn....	Precipitation	0.20	0 52	1.39	5.90	2.13	1.69	3.00	2.12	2.22	2.68	0.19	.....	.....
York.....	Mean temperature.....	25.5	27.8	35.1	49.4	60.8	74.7	80.5	74.3	74 8	56.4	33.3	23.8	51.4
	Highest temperature.....	50	50	60	76	88	105	106	100	95	91	70	50	106
	Lowest temperature.....	-7	-9	0	32	40	41	61	44	47	30	0	-12	-12
	Precipitation.....	0.50	1.10	2.80	5.45	2.24	1.76	1.60	1.68	0.72	4.52	0.60	1.30	24.27
	Rainy days.....	2	2	3	9	7	10	4	3	2	4	2	3	51
	No. cloudless days.....	15	11	11	14	18	10	28	19	16	18	14	14	188
	No. partly cloudy days....	3	9	7	5	4	11	3	3	7	4	8	8	72
	No. cloudy days	13	8	13	11	9	9	0	9	7	9	8	9	105
	Prevailing direction wind.	NW	S	N	S	S	S	S	S	S	N	N	S	S

Digitized by Google

REPORT OF THE CHEMIST.

By H. H Nicholson, A.M.

Chemistry.—The work of the Division of Chemistry for the past year has been, in the main, along the lines enumerated in my last report. The amount of work done on questions relating to the beet sugar industry has been largely increased, chiefly because of the co-operation of the Experiment Station with the United States Department of Agriculture in carrying out quite extensive experimental and development work in this direction. Further, what might be called a miscellaneous work of the Division, viz.: that which is brought to us through direct application from individuals throughout the state, has largely increased. Determinations of the moisture in soils have been made for the Division of Agriculture, the Division of Meteorology, and for individuals in different parts of the state.

While the immediate necessity for this line of work does not press upon us as it did during the season of 1894, yet questions important to agriculture can only be solved through the aid of this factor; hence it seems necessary to continue from year to year this line of work.

TESTS OF SEEDS.

Analyses and tests of seeds and grains have been carried out as before for the Division of Agriculture. As cited in the previous report, there is a possibility that grains richer in nitrogen than those at present grown in this part of the country may be bred by selection. Our work on seed variation seeks, then, for some physical characteristic of the grain which accompanies a high nitrogen content. The work in question carried out by this Division is along this line.

Samples of the two grains, wheat and corn, are taken for our experimentation. The sample in question is first separated into two parts on the basis of its specific gravity; the one part is called "light grain," the other "heavy grain." Portions of these two samples are next carefully analyzed and their variations, especially in the nitrogen content, noted. Other portions of the sample are then planted and the grain grown from these is analyzed and compared with the parent grain. In this way, in the course of some years, any possible connection between specific gravity and chemical content will be noted. If such exists, then it is hoped, by careful breeding, to obtain grains of a high nitrogen content. The method entails considerable chemical work, yet if it yields favorable results, it will be work well undertaken.

Germination tests were also made of all beet seed used and distributed

Digitized by Google

by the department. It would seem advisable to extend such work as this to all seeds and grains handled by the station, with the ultimate object of establishing a seed-testing station in connection with the other work done here.

The study of the progressive changes in beets has been carried out through the season after the same manner as has been outlined in previous reports. This work has now progressed for six years and a vast amount of data has been accumulated. I hope to be able to carry this study through a period of ten years. To make this data valuable one must have leisure to study and digest and put it in shape. I am convinced that results valuable to the beet grower and consequently to the state will be obtained in this way.

CO-OPERATIVE WORK.

The co-operative sugar beet work, in conjunction with the U. S. Department of Agriculture, has taken a large amount of time, especially in the way of distributing seed, printed instructions, and other information, and in collecting, analyzing, and tabulating results.

In brief, we received from the Oxnard Beet Sugar Company, at Norfolk, five hundred pounds of seed in bulk, April 5. This seed was thoroughly mixed and samples taken for germination experiments. It was then sacked in half-pound sacks and distributed in accordance with requests from persons over the state. Four hundred and thirty-three persons were furnished with seed gratis. At the time of sending out seed we sent to each individual printed instructions as to general methods of planting, cultivating, and caring for the crop, together with a printed blank.*

---

*For the benefit of those to whom sugar beet growing is a new business, the following suggestions in regard to soil and cultivation are offered:

Selection of Land.—The field selected should lie as nearly level as possible and should be a mild sandy loam with a good open sub-soil. By preference one should select a field that had been long in cultivation, has been well manured, and on which the previous crop was of small grain or roots rather than corn.

Preparation.—In general the following operation should be carried out: first, shallow plowing just after grain harvest, followed by deep plowing with a surface plow, followed by deep plowing, surface and sub-soil, to a depth of from sixteen to eighteen inches after the weeds have made their appearance. At present, and where fall preparation has been neglected, the ground should be plowed as early as possible in the spring to an ordinary depth with a surface plow, followed by sub-soiler to a depth of six or eight inches more. The surface should be thoroughly pulverized with a harrow and planked or rolled.

Seeding.—The seed should be sown in drills, or in rows, from sixteen to eighteen inches apart, and at the rate of from eighteen to twenty pounds* to the acre and covered to a depth of not to exceed one-half to three-fourths of an inch, according to the weather. Seeding should take place as early as possible after the ground has become warm, usually from the middle to the end of April.

Cultivation.—Cultivation should begin by shallow hoeing as soon as the rows can be seen. This should be kept up at frequent intervals throughout the entire season. When the young plants have reached the stage of having four leaves they should be thinned to a distance of from six to eight inches, depending largely on the richness of the soil. It is important for the future success of the crop that cultivation by hoe and cultivator should begin early and be kept up until the leaves shade the ground, and also that the thinning should not be delayed after the plants have four leaves.

FORM FOR DESCRIPTION OF SAMPLE SUGAR BEETS.

Laboratory No..... Received at Laboratory.....

Each sample of beets sent for gratuitous examination must be accompanied by one of these forms, with proper blanks below filled out fully and legibly. The filled out form, if enclosed with the sample, will serve as a label.

Date of taking this sample.....

Digitized by Google

Somewhat later in the season a large amount of material, in the way of bulletins, franks for free transmission of beets to Washington, and directions for planting, cultivating, and harvesting beets was received from the Department for free distribution. Under the advice of the director, copies of these were mailed to each person applying for beets. Still later, when the director of the station was made a special agent of the Department of Agriculture for sugar beet investigation, a large number of franks for the free shipment of beets to this station were received from Washington and mailed to persons taking seed from this division. Of the four hundred and thirty-three people taking seed, one hundred and fifty-eight, or about thirty-six per cent, responded in the fall either by sending beets and reports asked for, or by sending a report and no beets. Of these persons, one hundred and six supplied samples of beets for analysis and fifty-four reported failures. Of those failing to raise beets, 26.9 per cent attributed failure to dry weather; 26.9 per cent to poor seed; 25 per cent of the failures were caused by grasshoppers; 7.7 per cent were caused by stock destroying the crop; and 13.4 per cent were caused by general neglect.

Undoubtedly the small percentage returning beets to this station for analysis is, in part, to be attributed to confusion existing by their having received franked shipping tags directed to the Department at Washington, and also franked shipping tags directing them to send beets to the Experiment Station at Lincoln. It may be assumed that as many sent beets to Washington as did here. If this is the case, over 70 per cent of those receiving seed made some sort of return. The results of analyses show an average of 12 34 per cent of sugar in juice with a purity of 75 per cent. The highest per cent of sugar in juice was 16.8 per cent with a purity of 78.5 per cent. The lowest was 4 67 per cent sugar in juice with a purity of 45 per cent. We sent beet seed into sixty-seven counties of the state and received beets from thirty-six counties.

Another attempt was made this season to grow seed from beets. For this purpose mother beets of a high sugar content and purity were secured last fall from Mr. Huxmann, of Grand Island, and kept in the base-

1. Crop grown on ground the preceding year.....
2. Character of soil.....
3. How deep was the groun l plowed?.....
4. Exact area of plot planted.....
5. Variety of seed sown.....
6. Date of planting.....
7. How long before the plants came up?.....
8. Distance between rows.....
9. Distance between beets in the row.....
10. When did you thin out?.....
11. How many t mes did you use cultivator?.....
12. How many times did you hoe?.....
13. Give date of hoeings.....
14. No. lbs. of beets, under three lbs. in weight, raised on this plot.....
15. What fertilizer, if any us d?.....
16. Date of harvesting.....
17. Entire cost.....
18. Do you think from your experience o. this year that you could afford to grow beets at $4 per ton?.....

*By hand dropping the accompanying sample may be made to plant a quarter of an acre.

Digitized by Google

ment of the chemical laboratory during the winter. Early in the spring these beets were selected on a basis of chemical analysis and those with a sufficiently high sugar content and purity were reserved for analysis. They were planted April 6 in field 13, in such a manner that each beet was given nine square feet of ground from which to draw its nourishment. Immediately following the planting of these beets the weather became very cold and damp, and continued in this condition so long that nearly all of the mother beets were killed. The few that withstood the long continued cold weather of the early spring were so weakened that the yield of seed was insignificant. It is hoped that better success may be met with in this connection next year.

APPLES.

In my last report I mentioned the fact that we were at that time beginning an investigation of Nebraska-grown apples for the purpose of comparing these with apples of the same variety shipped into the state from abroad. This investigation took the direction of the analyses of the pure, fresh apple juice, and, at the same time, of the same juices after a certain degree of fermentation set in. Thirty-two analyses in all were made. On tabulating the results it was found that, as far as this investigation went, the juices of the Nebraska apples contained a larger amount of solid matter than those of the same varieties that were shipped into our markets from abroad. While these results were not conclusive, they point to an interesting line of investigation that might be carried out at some future time.

MISCELLANEOUS.

Besides the analyses necessary in these general lines, we have made, during the year, several analyses each of milk, vinegar, cattle foods, hog cholera remedies, apple pulp, soils, ashes, etc.

The correspondence of the division with the people of the state has been unusually large. I find from an examination of my letter files, that during the past year over five hundred communications relative to the beet sugar industry have been received and answered. Between five and six hundred letters have been received on various matters connected with agriculture and other problems.

Of the data obtained through our various lines of experimental work, enough is on hand to warrant publication of one or more bulletins when time is given for the proper study, comparison, and digestion of the facts obtained.

Digitized by Google

REPORT OF VETERINARIAN.

By A. T. Peters.

IMMUNITY.

This is a subject that has attracted a great deal of attention in the medical world both abroad and in this country since the time of that master of vaccination, Jenner, and that pioneer, Pasteur, who really demonstrated the power of immunity when he showed his results of vaccination against anthrax in 1881. Since then vaccination has been practiced in various diseases with marked success. But it has been found that immunity may be produced not only by vaccination but also by the sera fluids, and this subject of serum therapy has been uppermost in the minds of the medical men since the discovery of Behring's diphtheretic and tetanus antitoxin. Both have been greatly modified in the technique of preparation, and there have been theories and theories advanced as to their relation to immunity. So I will endeavor to discuss immunity produced not only by vaccination but also by the sera fluids.

Immunity may be natural, hereditary, or acquired. It would be useless for me to go into minute details in regard to natural and inherited immunity, so we will give the most of our attention to acquired immunity, as that concerns us in combatting contagious diseases.

INHERITED IMMUNITY.

As an example of inherited immunity, I will refer you to the Algier sheep. All of you who are acquainted with the literature of anthrax know that this sheep is immune from anthrax and can be pastured on infected land that is extremely fatal to other species. This breed we find inherit their immunity.

NATURAL IMMUNITY.

To illustrate natural immunity, I will repeat what experimenters in the laboratory have for a long time known, that field mice are not susceptible to septicaemia. Another instance that is familiar to all veterinarians is that no case is recorded in the history of veterinary medicine in which the cow has contracted glanders.

ACQUIRED IMMUNITY.

Acquired immunity may be effected by the recovery from an attack of a disease or by inoculation against subsequent attacks. But acquired immunity may not always be effected in this way, as certain diseases are recurrent. For instance, one attack of malaria renders a person even more susceptible to a second attack. Consequently inoculations in such cases cannot produce immunity. On the other hand, it has been clearly dem-

Digitized by Google

onstrated in New York and also in our own laboratory that diphtheria convalescents carry the diphtheria bacilli in the sputa or excreta with impunity. It has also been reported that cholera patients have passed the comma bacillus for weeks after recovery.

In inoculating against diseases there are many things to influence susceptibility and immunity. Age appears to exert some influence, as young animals are more susceptible than older ones. This is especially true in the case of hog cholera. For the last four years our records show that over 88 per cent of the hogs that succumbed weighed from fifty to 150 pounds. This is also true with horses and influenza.

The strength of the virus is also an important factor. It is well, therefore to know the strength of your virus and dose accurately, according to the size of the animal. For example, it would not do to inoculate first with the second vaccine of anthrax and omit the first, for you would certainly meet with disaster.

The temperature also plays an important part. For instance, the normal temperature of the fowl is 107.3°F. Consequently the fowl is exempt from anthrax until the body temperature is reduced by artificial means so that the germ can grow.

Heredity likewise exerts considerable influence in certain cases in the production of immunity. Duclert found in sheep-pox that animals from an immune mother possessed either relative or absolute immunity. To show the effect of an immune father on the offspring, Ehrlich made six experiments with an immune father and susceptible mother, with the result that not even a temporary immunity was transferred to the young. But even the mother does not always transmit immunity. We have made experiments along this same line. At conventions of swine breeders the question is often raised as to whether or not a litter of pigs would be susceptible to hog cholera if the sow had had the cholera at the time of pregnancy. There seems to be a difference of opinion among the stockmen, so it was decided by our departments to buy a litter of pigs that were from a sow that went through an attack of the cholera at the time of pregnancy, and place them in infected herds where undoubted cholera existed. This was done, and in every case the pigs died. From this experiment, together with the statements of stockmen who have since observed the same, I think that the progeny of a mother immune against hog cholera are not immune, nor do I think that they are in any way rendered less susceptible to the disease.

In some diseases, as small pox and measles, one attack gives the subject an immunity that may last him a life time. On the other hand, an attack of diphtheria or relapsing fever gives an acquired immunity that lasts only for a limited period, after which there is danger of a second attack. In still another type of disease no immunity whatever is produced. These diseases are tuberculosis, leprosy, and cancerous diseases, and although vaccination has been tried it was of no avail. Hospital patients treated with tuberculin seem to recover for a period of one or two years, after which time the disease breaks out with renewed vigor. So, to

Digitized by Google

assure acquired immunity by vaccination we must use cultures of those microbes which produce a large amount of toxins, and not those which produce no symptoms of poisoning when the pathological microbe is present.

THEORIES AT TO THE CAUSE OF IMMUNITY.

The duration and cause of immunity depend on factors of which we have no certain knowledge. The different investigators have expounded different theories. The most noted is the hypothesis of Metchnikoff's famous theory of phagocytosis. He says that the cells of the body, such as the phagocytes, have the power of destroying by digestion the micro-organisms that invade the circulation, and thus protect the body from infection. If, on the other hand, the phagocytes are incapable of preventing the growth of the infectious organisms, the bacteria get the upper hand, and the animal suffers fatal infection. Again if the amoeboid cells succeed in warding off the attack, they habituate themselves to the action of the germs and are thus able to resist this germ as long as the immunity lasts, the time varying, as has been shown, in different diseases.

Buchner has put some restrictions on this theory. Since he has shown that after the leucocytes are destroyed by freezing, the bactericidal power of the blood still remains. He later concludes that, although the leucocytes do furnish a germicidal power, they do not do so as a rule by actual digestion of the germ. Other observers have since noted that the bactericidal power of the blood is contained in the leucocytes.

Pasteur explained the phenomenon in this way: the pathological micro-organism of each specific disease finds a special pabulum on which to live, and so soon as this becomes used up it can no longer exist. Hence the animal remained immune until this pabulum was renewed in the system.

Chauveau explained the matter from a chemical standpoint. He suggested that acquired immunity was due to a waste product of the germ, which remained in the system, and in which the germ itself could not live. This is illustrated by the yeast plant, which in growing produces alcohol, which in turn prohibits further growth of the germ.

All these theories have been vigorously attacked by Behring, who has done so much in serum therapy in the last seven years. His theory, which has been quite generally accepted, is that the host elaborates a specific antitoxic substance which chemically neutralizes or antagonizes specific toxins as acids neutralize bases.

The latest theory at our command is the so called "granular theory," that there are present in the blood free granules derived from the leucocytes that destroy the pathogenic germ. This has just been recently advanced, in a paper read before the Johns Hopkins Hospital Medical Society, October 18, 1887, by Drs. Stokes and Wegefarth. They conclude by advancing the following theory: "The bactericidal power of the leucocyte of the blood, and of the serum of man and many animals, is due to the presence of specific granules, especially the eosinophilic and neutrophilic. When

Digitized by Google

called upon to resist the action of invading bacteria, the granular leucocytes can give up their granules to the surrounding fluids or tissues. Not only does this enable us to understand how apparently cell-free fluids can destroy bacteria, but the production of the alexin by the leucocytes also affords a better explanation of the hyperleucocytosis of infection so strongly urged by Metchnikoff, and by no means disproves the supposition that the leucocytes can take up bacteria either while alive or after being destroyed by means of the germicidal granules."

But no matter how much these theories differ and antagonize each other, they all agree in one thing, that the germicidal power of the blood lies somewhere in the serum. In accordance with this fact the investigations and discoveries of Behring have shown that if the toxin of a pathological organism be injected in proper quantities for a sufficient length of time into the body of one of the higher animals, the blood serum of this animal acquires specific antitoxic properties; that is, a given quantity of this serum injected into another susceptible animal would render it immune. And it is by this means that the medical profession is scoring one of the greatest triumphs in modern medicine.

I will now endeavor to discuss the more important contagious diseases in which immunity may be acquired by vaccination or by the introduction of blood serum from immune animals.

RABIES.

Pasteur's treatment of rabies is undoubtedly known to all of you. His cure consisted in killing rabbits suffering from rabies and injecting an emulsion of the old and dessicated cord into the system of the animal he wished to immunize. The first injection was followed by repeated injections of fresher and fresher cords until absolutely fresh and virulent cords could be injected with no effect. Since the time of this discovery thousands of patients have been treated by this method, and institutes for this purpose have sprung up all over the world.

ANTHRAX.

Pasteur found that by exposing the anthrax bacillus to abnormal heat, it gradually lost its virulence. Furthermore he noted that sheep inoculated first with a bacillus of little virulence and secondly with one of greater virulence were protected against subsequent inoculation of a virulent culture that proved fatal in an animal not so protected. A public test of this experiment was made, in which twenty-five sheep were vaccinated by this method, another twenty-five were left unvaccinated, and all were publicly inoculated with a virulent culture of the anthrax bacillus. The result was a perfect success. All the unvaccinated animals died of anthrax; the vaccinated ones were not even ill. Since 1881 vaccination for anthrax has been practiced all over the world, and "in France alone during the twelve years succeeding its introduction the saving has been estimated at about 300,000 sheep and over 20,000 head of cattle."

Digitized by Google

BLACK LEG.

Black leg was for a long time thought to be identical with anthrax, but through the labors of Arloing, Cornevin, and Thomas, a specific germ for this disease has been isolated. I do not think it wise to take up too much time in the discussion of the efficiency of vaccination in this disease, but I would like to emphasize the fact that all veterinarians should thoroughly acquaint themselves with the method, what has been done here and abroad toward decreasing the annual loss, which is larger than is generally thought. If the veterinarian will do this and compare the results with those obtained by using the old remedies, he will stick to vaccination and become a useful man in the community where black leg exists.

PLEURO-PNEUMONIA.

Vaccination is practiced in pleuro-pneumonia in Europe, where the disease is known to exist. I quote from an article by "Ecrivain" in the *Veterinary Journal*, Vol. XLII, No. 251: "It has not yet been fully determined how long the immunity lasts, but still, if it carries over the outbreak, it would save the life of many a healthy animal. The virus is taken from the inter-lobular connective tissue of the lung in the first stage of a mild attack, when it will be loaded with a semi-fluid exudate. The fluid is collected, filtered, and put into sterilized tubes, which are afterwards sealed by the blow-pipe. The tip of the tail is the part selected, and scarification is quite sufficient on the under surface, one drop of the filtrate being quite sufficient for protection. * * There has been some argument whether inoculation produces the same disease or not, but whatever it produces, it is a great satisfaction to know that it produces immunity.

VARIOLA.

Variola runs a mild course in cattle and renders the animal immune. Persons milking cows with this disease may become infected through an abrasion and thus become immune against a subsequent attack of this disease as well as against human small-pox.

TETANUS.

The serum treatment of tetanus has interested the veterinary profession for the last seven years. It was hoped for a time that the antitoxic serum would be effective as a curative agent, but the recent experiments and data at hand have clearly demonstrated that when the symptoms of clonic spasms have set in, the serum has only a limited curative effect. Professor Nocard states that it is a good prophylactic. It should be used, therefore, in localities where tetanus is known to exist, in cases where valuable horses received deep seated punctures that have a tendency to heal on the outside, as the bacillus is anærobic, so that wounds with good drainage are not so liable to infection.

RINDERPEST.

Germany is especially fortunate in having strict sanitary regulations in

Digitized by Google

combatting rinderpest, but this still runs unchecked to a great extent in Africa, Russia, and certain parts of Austria. Recently the English government has secured the services of Dr. Koch to investigate this disease in Africa. The report of his work is more or less familiar to all of you, who have no doubt watched it with unbounding interest. At first the treatment consisted in the injection of serum from animals that had recovered, but these animals that received the serum showed only a limited protective power. So the next step was to try vaccination. This was done as follows: the bile was taken from an animal immediately after death so that no putrefying germs were present, and placed in a sterilized flask and treated with glycerin. Animals treated with this experimentally could after certain days receive virulent blood under the skin with impunity, while the control animals died. It has been shown that the protective power lasts three months in cases where glycerinated bile was injected. But even if the immunity were absolute only for this short period, it would be practical to inoculate the animals every three months if the disease is suspected in the neighborhood. The glycerinated bile is used because the disease can not be spread by its use, and, secondly, great economy is effected by the use of glycerin, and, thirdly, the mixture will keep. Pure bile is undoubtedly the most powerful, but even that is not so powerful in producing immunity as the disease itself, from which immunity lasts in Russia about five years. The French experts claim that by using 100 c.c. of serum to a dose an immunity lasting two months will result.

Drs. Turner and Kolle, who have continued the experiments begun by Dr. Koch, have experimented with serum and with defibrinated blood, the action of both being found precisely similar. They conclude that infection must be insured of as definite and severe a character as possible, and at the same time administer the serum in such a dose as to insure the safety of the animal. This is done by injecting 1 c.c. of virulent blood on one side of the animal, and immediately afterwards 5, 10, 20 c.c. of the serum on the other side. The animal suffers from a modified form of the disease, showing all the usual symptoms, and is salted.

TEXAS FEVER.

The recent investigations in Texas fever in this country and in Australia are all fresh in your memories, as the cause of this disease has only recently been agreed upon. Dr. F. L. Kilborne deserves a great deal of credit, as he pointed out in '89 and '90 that the tick was the cause of the spread of the disease. It took some time before the stockmen and scientists would believe that the innocent looking tick was at the bottom of it all. Many of you will recall men saying "no ticks, no Texas fever," and you will also recall what a warm reception was tendered the gentleman who made such a remark. But however fishy it sounded then, I think the work of the Missouri Experiment Station has now confirmed the "tick theory" beyond the shadow of a doubt. I mention this disease in connection with immunity because Dr. Connaway of the Missouri station has

Digitized by Google

performed experiments in which serum was taken from naturally immune southern cattle and injected into susceptible northern cattle with the view of producing immunity. One animal was immunized in this way, and withstood the disease when infected with the tick. The various experiments made along this line do not as yet give sufficient evidence to justify one in stating that the serum will prove an absolute prevention, but the reports are encouraging, to say the least, so that we may hope for a great revelation in the cattle industry of the South.

HOG CHOLERA.

Probably the disease most interesting to stockmen is hog cholera. Vaccination against this disease has been in vogue for some years, but recently experiments have been made with the serum treatment. Dr. Lorenz, of Darmstadt, Germany, has experimented with serum taken from immune rabbits and pigs, which proved successful, and his method was bought by the German government of Prussia for the purpose of making their own serum and establishing stations for that purpose all over the country. These experiments have been watched with marked interest by all that are familiar with the foreign literature. It has been recently announced that he has secured a chemical from the serum which he claims contains the protective power. Dr. Paul Toepper, B. T. W. No. 4497, announces that he has inoculated animals with this protective chemical and has not had very good success with it.

The results of similar experiments carried on at the Nebraska Experiment Station in 1896 were reported before this body last year. These experiments have been continued through '97, about 2,000 doses having been sent out. At the present time I cannot state the exact number treated and the results of same, as the reports are not yet at hand, but the reports we have received so far are very encouraging over the previous year's results. We have given a virulent culture in connection with the serum and have demonstrated that by this method we could not give the disease so that the slightest symptoms were shown. We have also treated piggy sows by this method without producing abortion or any deleterious effects. By this combination of the toxin and the serum we have succeeded in lengthening the period of immunity, which accounts for the better results.

In our study of the efficiency of serum we have in the past year learned many new things, one of the most important of which is the fact concerning filtered serum. Our laboratory and field experiments showed that serum lost some of its protective power by filtering it through a porcelain bouge. We have also shown, to our own satisfaction, at least, that serum alone has much more limited power of immunity than does serum in combination with virulent blood.

We have made only a few experiments with dried serum, and they were laboratory experiments on rabbits. But those that have used the dried diphtheretic serum claim that it is unreliable. The principal objection to

Digitized by Google

it from a laboratory standpoint is that it is not readily soluble in water, and this fact alone, I think, would condemn its universal use.

We are watching with interest the experiments of Dr. Summers, of Berlin, Germany, who is trying to make a more concentrated serum, and thus lessen the size of the dose. The idea is to get rid of the water that the serum contains by some means that will not injure the protective properties of the material. He has shown that by freezing the serum a darker portion settles to the bottom of the flask. This, it is found, is the protective part, while the watery portion remains as a layer on top. We have observed this in our own laboratory, and have also noticed that some serum is very difficult to freeze; hence we conclude that it contains less water and is possibly a stronger serum.

I have tried to demonstrate to you the value of acquired immunity, and bring out some of the latest investigations that seem to speak so highly for the sera fluids. I am ready to answer any questions that I can, and thank you for your attention.

Digitized by Google

REPORT OF THE GEOLOGIST.

By Erwin Hinckley Barbour.

THE VALUE OF WATER AS A SOIL ELEMENT.

If one would find the spot where mines and ledges of precious ores are appreciated to the extent of worship he has but to breathe the air about him, for the incense of the worshipers of the mine has prevaded all time and space.

If he would find the spot where legislation discriminates for the mine almost to the exclusion of other industries he has but to look around him.

If he would look for the spot where a state bounty is offered for the discovery of a natural resource he need not look beyond the confines of his own commonwealth, and will see that the bounty is offered for the discovery of a coal mine.

Now, if the same zealous citizen were to hunt for the spot where water is recognized as a natural resource of profoundest importance; where it is fully appreciated; where it is legislated for; where bounties are offered for the discovery and development of this greatest national resource; he would circumnavigate the globe, finding but few spots where the agricultural importance of water has full recognition.

The development of water as a natural resource in the great plains alone would exceed in importance the output of all the mines of Christendom combined. In the light of the present tendency of all classes of people to sympathize with the sentiment that there should be a greater distribution of wealth among a greater number of people, it seems all the more inexplicable that attention should be so universally focused upon the mine—which centralizes capital in the hands of a few—and away from agriculture, which distributes wealth to the masses.

Yet such is the case. The mine has the glitter and fascination of the lottery, and the splendor of riches suddenly acquired by a few, dazzles the eye and blinds it to the importance of slower, steadier gains acquired by the many.

COMPARISON OF AGRICULTURAL AND MINERAL PRODUCTS.

The agricultural products of Nebraska—a state in her infancy as yet—amount to $205,000,000 annually, divided among 175,000 farmers. This is a regal sum, but its lustre is dimmed in the popular mind by the much smaller sum, $35,000,000, which is annually piled up by a few capitalists from the gold and silver mines of Colorado.

The total production of gold and silver in the United States equals $60,000,000 or thereabouts, annually; while the total agricultural prod-

Digitized by Google

ucts of our own state are $205,240,000, and the reader is left to draw his own inferences as to the relative importance of the two great industries, mining and agriculture.

It is a fact not generally known that many people of Nebraska, blindly infatuated with a desire for mines and precious ores, spend, in the aggregate, $20,000, annually, in the eastern half of the state, vainly prospecting for impossible things. Yet in this same region, that magnificent resource, water, wells up above the surface and goes to waste, with but here and there a man sufficiently discerning to utilize and develop it. The tendency toward debasement of agricultural development, and the exaltation of the mine has been borne in upon the writer so forcibly that he must be pardoned if he speaks rather freely, feelingly, and at some length upon this matter. For, during the past few years, his endeavors to obtain for the general government facts and figures to assist in the understanding and development of our water resources for the benefit of agriculture have met with tardy response or with open opposition.

IMPORTANCE OF THE WATER QUESTION IN NEBRASKA.

Every citizen must know that our commonwealth is one whose broad extent exalts it to the dignity of an empire, where millions may live in comfort, or at least with something over and above bare subsistence; whose agricultural possibilities cannot be foretold; whose fertility is known to be unbounded. At the same time he cannot but realize that this vast domain is too sparsely peopled; its resources are not developed; and its remarkable fertility amounts in some cases to actual sterility.

All this is due to one cause and but one, and that cause is insufficient rainfall. Consequent to our limited precipitation and general lack of ample moisture, the fertility of our soil, though superabundant, cannot be rendered available as plant food, and our agriculture, which is the very basis of our wealth, suffers serious loss, and with it other industries in a like degree.

This, then, raises the water question in so extensive a region to the proportions of a national problem.

It is the question of paramount importance to Nebraska and sister states, on whose solution hangs prosperity. This solved, all is solved so far as our agriculture is concerned. Give the Nebraska agriculturist part or all of the moisture according as his crops require it, and at the time they most need it, and he is rendered self-sustaining or independent from that day.

If this is true—and popular opinion, backed by careful investigation, seems to sanction the decree—then, in all conscience and consistency, the citizens whose deepest interests are at stake, whose material welfare and betterment are a subject of patient inquiry by the state and government, ought to co-operate to a man.

DIFFICULTIES IN OBTAINING WELL STATISTICS.

This is to be expected, but never to be realized, as will plainly appear. During the recent period of drought, which caused an exodus of thou-

Digitized by Google

sands of citizens from the state, and frightened as many more from immigrating into it; when whole counties were nearly depopulated and the state treasury ran low, it seemed to the government expedient to remedy this by getting facts about our water supplies. It was important to have at hand data from which authentic reports could be made respecting the depth to water, and the quality, quantity, and constancy of our water supply. The object of this was two-fold. It would enable the resident agriculturist to take advantage of such information for the benefit of his crops or herds, and would afford the prospective resident a basis on which he might make rational plans. This work, undertaken by Professor F. H. Newell, hydrographer of the United States Geological Survey, was conducted on a magnificent scale, comprising the whole United States, but more especially the Great Plains. The work of obtaining facts from Nebraska was put in the hands of the local geologist of the state, the writer of this paper.

Not only did the government, in pursuing this inquiry, furnish stationery and blanks for the answers to a few simple questions respecting the water conditions in Nebraska, but it also furnished addressed envelopes and free postage. It cost nothing whatever to reply to these important inquiries, yet in eighty cases out of a hundred these were cast aside or were returned to the writer unanswered; and it was only by importunity that fifty answers out of one hundred letters could be obtained. The general government was often openly denounced, and the writer blamed to his face for spending time and money upon this really important inquiry instead of dividing it among the poor, which would have given them the munificent amount of about four cents each, and would have left present and prospective citizens with no exact knowledge on which to base future enterprises.

Some contended that they were overtaxed already and should not be forced to pay for this inquiry; showing supreme ignorance of the fact that the government gets its revenues by taxing liquors, tobaccos, imports, and luxuries, and that it costs them nothing to have this investigation conducted in their community. This furnishes additional grounds for the advice that we should talk less and inform ourselves more. It is a sad comment, yet it is nevertheless true, that the answers varied in an inverse ratio to the rainfall. When crop conditions were favorable and precipitation ample, scarcely 15 per cent of answers could be extracted. But with every recurrence of drought, the proportion of answers ran up to about 62 per cent. It was only after persistent effort that a single answer could be obtained from five important counties, namely: Boyd, Dakota, Jefferson, Sherman, and Thurston, representing a total area of 2,485 square miles, or twice the area of the state of Rhode Island, or half that of Connecticut. Settle the water question, and the matter of subsistence in Nebraska is settled; the people know and believe this; none the less the inquiries of the government are neglected.

There is such a turn in the tide of existing affairs that there is, the country over, pretty pronounced class legislation, and that class the

Digitized by Google

farmer. Legislative bodies, universities and colleges, agricultural experiment stations, and public institutions are engaged in the consideration of ways and means for bettering the condition and furthering the interests of one class, and that class the farmer. This is right and just, and as it should be. But when one is the recipient of distinct class legislation, then, in all honor is he bound to respond to those having his interest at heart, and who are devoting large public appropriations to his special interests. The merited responses, however, have not been forthcoming.

The answers from farmers will not run as high as 40 per cent, while the answers from those classes not legislated for, such as merchants, blacksmiths, carpenters, and other artisans, will reach 90 per cent. This seems to be a matter worthy of more than passing notice in this report, for it cannot but fall into the hands of those who will realize and grant the injustice of such neglect; whose minds will be sufficiently broad and receptive to admit the importance to our state of such governmental aid; and whose influence may be thrown into the creation of a sentiment for cooperation.

The United States geological survey purposes, in pursuing investigations in Nebraska, to get together a vast amount of data from which to draw facts for the amelioration and modification of our agriculture, so as to meet the exigencies of our time.

It is the work of a few moments only to fill out these government blanks, and it is certainly time better spent than in denunciation of Providence, disloyal complaints against the government, and abuse of the state, such as have been too common of late from certain classes. Such open denunciation comes largely from a misguided and unsuccessful class.

In frontier states the population is new and untried; it is a heterogeneous aggregate of people from the states and from foreign nations. In migrating into frontier states people are generally actuated by a desire to better their condition, or else they are driven thence by their own failures. The first class becomes the pillars of our commonwealth, while the latter class is often a failure in the West, as well as in the East, and their lack of success and complaints have cast unfavorable reflection upon a magnificent commonwealth. It is this class which does the roving from state to state. But with the disappearance of these and the steady growth of a better class, with habits of industry and frugality, and with fixity of purpose, there is bright hope of the reclamation of valuable and very extensive tracts in the sub-arid and arid plains by means of closer cultivation and by the art of irrigation.

The roving class, as a whole, and the older members of the sturdy class are not susceptible to new ideas, but their sons are more amenable to change and readily adapt themselves to new conditions, and herein lies the hope of the future development of our greatest natural resource—water. Let the government continue the work of collecting and disseminating useful knowledge, and there cannot but come encouraging results along all agricultural lines.

Digitized by Google

The natural resources of Nebraska are few. Its rocks are level, and generally buried deeply from view. There are virtually no minerals, no beds of coal, nor veins of ore, no fields of gas nor oil, and its citizens, forgetting our clay beds, lime beds, ochre beds, and other resources, think the state unworthy of a geological survey. Yet there is the one greatest resource—water—which once developed will yield unlimited returns.

The surface water has a limit, and some of it may be, and has already been, totally diverted by other states. Yet that forgotten source of water supply, the underflow, or ground water, is inexhaustible.

Let papers with cuts innumerable, with words few and free from technicalities, be circulated by the government explaining the action of water, its conservation and use, and its effects upon vegetation, then with these simple elements of soil and crop anatomy a young farmer may have a correct understanding on which to base his diagnosis.

Exact facts respecting the surface and ground waters of Nebraska are not known, simply because no geological survey of the state has ever been made. Accordingly little can be said about the utilization of water in many regions. As a result citizens and emigrants must determine these matters by costly experiment. This is one of the many things which the government survey proposes to correct. An understanding of the im-

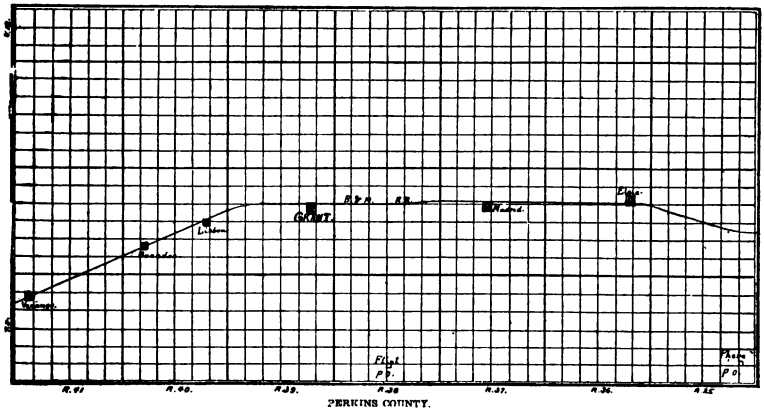


FIG. 1.—A map of Perkins county, Nebraska, used as an example of the type of map which has been standard in the state for years. Erase the imaginary lines and little or nothing remains. Such maps convey no information to resident or prospective citizens. And yet they must be used until the geologic and topographic survey can replace them by accurate maps. Compare this map with the one represented in Fig. 2.

portance of exact work may be perceived better than described. Accordingly the reader is respectfully referred to Fig. 1, which shows—or pretends to show—the geography of Perkins county, Nebraska, a county of some 892 square miles and about 5,000 settlers. What knowledge can a resident or prospective citizen gain from a map consisting almost wholly of imaginary lines? And yet this same map has been the standard for years, and has been published over and over again, spoiling a great deal of good paper in

Digitized by Google

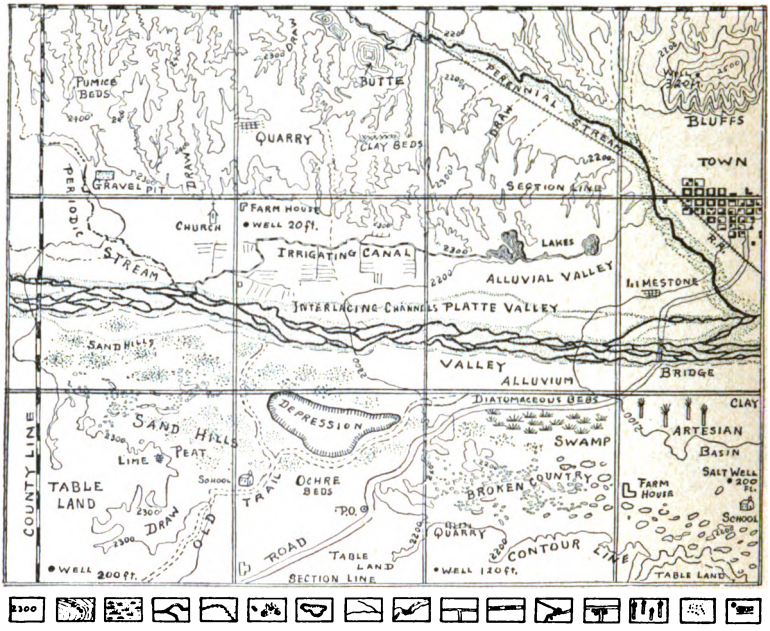


FIG. 2.—A map showing in a simplified way, and without colors, the main features of maps produced by the Geological Survey. Such maps as these furnish exact information for the guidance of resident and prospective citizens alike. Compare with Fig. 1. These maps show the elevations and depressions of the surface; the rivers; the perennial and periodic streams; the artesian basins, wells, springs, lakes, and even the marshes All roads, trails, irrigating canals, quarries, clay pits, gravel pits, and other deposits are correctly shown, thus furnishing a fund of exact information.

which tea, coffee, and spices might have been wrapped. Contrast with this the exact maps which the geological survey is making in Nebraska, in which is shown every draw, creek, stream, river, canyon, spring, marsh, swamp, artesian basin, lake, farm house, school house, church, town and city, every sand hill, hill, and butte, trail, road, railroad, canal, irrigating ditch, bridge, and the exact altitude of every acre on every man's farm. See Fig. 2. Besides, it shows the exact geology of every man's farm, locating deposits of all kinds. What a fund of exact knowledge on which to base enterprises! How strikingly it stands in contrast to the inaccurate work which has been accepted heretofore!

But notice that the work does not stop here at what is seen on the surface. It shows not only the soils and subsoils, but also the bed-rock below. It shows not only the surface water of the state, but it goes deeper and shows the depth of ground water, that is, how deep to dig for ordinary wells, and for artesian wells. It records the quantity and quality of the water from the surface down through the rocks to a depth of 2,463 feet, which is the deepest boring made in the state as yet. Fig. 3,

Digitized by Google

FIG. 3.—A map showing several farms, with draws and streams, etc. By means of such a map as this a farmer can tell the depth to water on any part of his farm. This figure, coupled with Fig. 2, will help to show the general plan of the maps of the Geological Survey.

Now comes a direct application of the benefit of such exact knowledge touching the water resources of the state. By careful measurements Professor O. V. P. Stout has learned that the total supply of surface water in Nebraska available for the purposes will irrigate but about 5,000 to 6,000 square miles at most. That is about the area of Scott's Bluff, Banner, Kimball, and Cheyenne counties, as may be seen in Fig. 4.

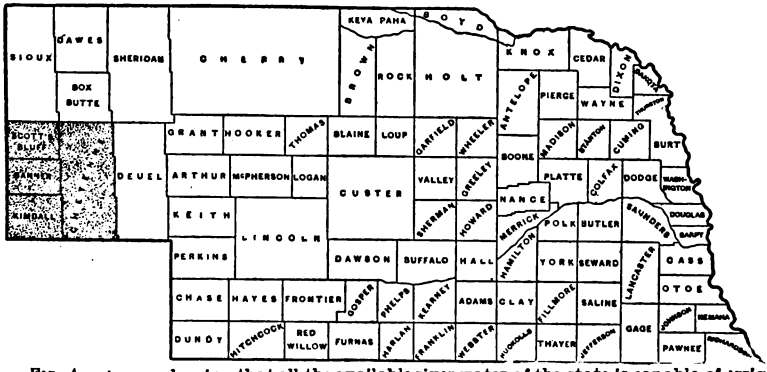


FIG. 4.—A map showing that all the available river water of the state is capable of irrigating a total area no larger than Scott's Bluff, Banner, Kimball, and Cheyenne counties, that is about 5,723 square miles. [After Professor O. V. P. Stout.]

Digitized by Google

This tract, though large, is small as compared with the non-irrigated portion of the state. But in addition to this the geologist, by his examination of strata and well records, is acquiring knowledge of an underground source of water supply of such magnificent extent that it must lead ultimately to the reclamation of valuable tracts of waste land throughout arid and sub-arid Nebraska.

Before considering the development of our water resources more in detail, it may be well to rehearse some facts about our moisture not generally known. This cannot be done better than to quote, as is so often done, the words of Professor Milton Whitney, Chief of the Division of Agricultural Soils, U. S. Department of Agriculture:

"The so-called arid portion of Kansas and Nebraska is, broadly speaking, that portion of the states lying west of the one hundredth meridian; between the one hundredth meridian and the ninety-seventh the climate is called semi-arid; and east of the ninety-seventh is the humid portion of the states.

The mean annual rainfall of the western or arid portion is from 15 to 20 inches; of the central or semi-arid portion, from 20 to 30 inches; and of the eastern or humid portion, 30 inches and over. There are, of course, no sharp lines separating these divisions, nor do the boundaries approach a north and south line, for the belts of greater or less precipitation have very sinuous courses.

"It is generally conceded that twenty inches of well-distributed rainfall in Kansas will make an abundant crop of wheat or corn. That there must be some rather anomalous conditions here is shown by the fact that in much of the humid portion of the eastern United States there has never been so little as twenty inches of rainfall within the period of reliable records, and in years of most disastrous drought the rainfall has been greater than this. The fact that a crop can be made in Kansas and Nebraska with such a small annual rainfall is particularly striking when it is remembered that, owing to the drier condition of the atmosphere, evaporation is very much greater there than in the East.

"There are localities in the West where the total annual rainfall does not exceed six to eight inches.

"It does not seem possible that with this rainfall, under ordinary circumstances, crops could be produced by any system of agriculture, unless water were artificially supplied. However, it seems possible, outside of these exceptional cases, that with improved methods of cultivation the conditions actually existing can be so utilized as to secure reliable and satisfactory crops.

"Statistics show that in the humid portion of the United States, having a mean annual rainfall of about 40 inches, 50 per cent flows off into the streams and is of no direct benefit to agriculture. This excess of rainfall reaches the streams partly by flowing over the surface of the ground and partly by slow percolation through the soil. Fifty per cent of the rainfall, or twenty inches per annum, evaporates directly from the surface of the soil, or is transpired by plants.

Digitized by Google

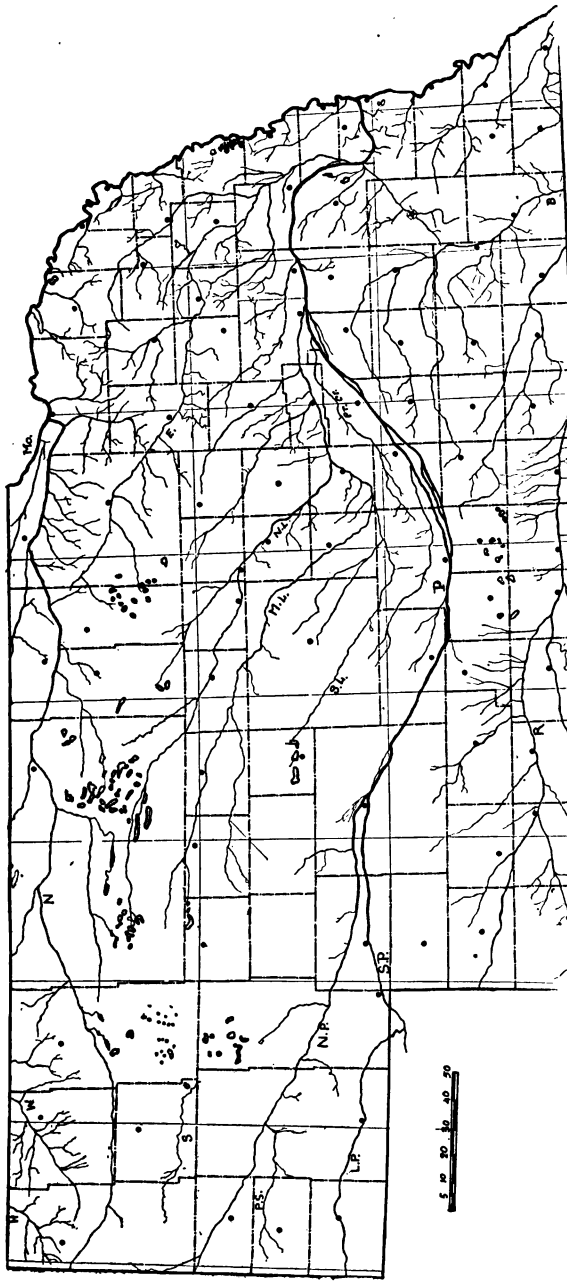


FIG. 5.—A map of Nebraska showing its system of rivers and lakes. With the exception of the White river and its tributaries, all our streams flow in noticeably parallel lines toward the southeast. The Loup system flows for many miles parallel to the Platte, because the Platte has been steadily building up its bed, and thereby choking off these rivers and compelling them to flow to lower levels before entering the Platte.

Digitized by Google

"Practically, therefore, there are about twenty inches of rainfall at the disposal of agricultural plants, and the highest art of cultivation consists in conserving this moisture, reducing that lost by evaporation from the surface soil to a minimum, and maintaining a sufficient amount at all times at the disposal of crops."

"In the arid portions of Kansas, Nebraska, and Colorado, with a mean rainfall of nearly or quite twenty inches per annum, statistics of the gaging of rivers and streams show that 10 per cent, or two inches of the rainfall, flows off into streams, and is of no direct benefit to agriculture. This gives, broadly speaking, eighteen inches of rainfall available for agriculture in the arid regions, as against twenty inches of available rainfall in the humid portion of the United States. Statistics show likewise that the greater portion of this rainfall in the arid region comes during the growing season. From April to the last of August they have an average rainfall of between three and four inches a month."

"It appears at first sight a rather anomalous fact that there is nearly as much available rainfall in the arid region as in the humid region, but there are several modifying circumstances that must be borne in mind. In the first place, the humidity of the atmosphere is very much less and evaporation is very much greater in the climate of the arid regions. Statistics show that the annual evaporation from a free water surface in the arid region is about sixty or eighty inches. In the humid portion of the United States the evaporation from a free water surface is equal to about thirty inches per annum. Roughly speaking, therefore, the amount of evaporation is twice as great in the arid region under consideration as in the humid portion of the country. Relatively more of the rainfall would, therefore, evaporate from the soil, and relatively less would be available to plants. It would also seem that plants would transpire much more water and would require a more abundant water supply in the arid climate. It will be remembered, too, that there is practically no excess of water in the soils as in the soils of the humid region to make these eighteen inches more available to plants. The fact remains, however, that in years of normal rainfall well distributed over the growing season, small though it is, a good crop is obtained throughout the semi-arid region, and even in the so-called arid plains, where the land is properly cultivated.

"The fact that they can make a crop at all with an annual rainfall of wenty inches under the conditions which have already been considered is surprising, and indicates that there must be conditions which are not strictly comparable with those in the humid region, and that there are advantages to counteract the apparently unfavorable conditions."

In considering our water problem as a whole, it may be expedient to review certain facts respecting our precipitation, evaporation, and soil moisture:

THE ABSORPTION OR IMBIBITION OF WATER.

When storm water falls upon our soils

1. A portion flows off..... { Washing eastern or clayey soils badly; not so in Nebraska, save in the Bad Lands.

Digitized by Google

2. A portion soaks in..... { Because our soils are sandy; not so in clay soils. Cultivation helps catch more water.

3. A portion is evaporated { Average evaporation in Nebraska about four and one-half feet per year.

FREE WATER OR GROUND WATER.

That which soaks in, though lost to the eye, is not lost to the state, for it sinks by gravity deeper and deeper into the soil, and constitutes what is called the free water or the ground water, from which our common wells are supplied. This is one of several ways in which water is held in the soil.

CAPILLARY WATER.

But when the rain stops and there is no more storm water to sink into the soil and the surface becomes dry, then begins a process of great interest, and of profound importance, called capillarity, whereby water is drawn or sucked up through all the minute hair-like passage-ways of the soil, thus rising automatically as much as six or seven feet. This, then, is a second way by which water is held in the soil, and its far-reaching importance is at once apparent when we stop to consider that the very passage-ways up which this water is drawn are those down which rootlets grow; that is, soil moisture carrying soluble plant food is carried to the growing rootlets. This force in Nebraska soils is such that vegetation can withstand long continued and severe drought, if not accompanied by hot winds. The same drought elsewhere would work destruction to crops. Our vegetation is fed by capillary water, and saved by it in time of drought.

But it ought to be emphatically stated that capillarity works equally well both ways, up or down, according as the surface soil or the deeper subsoil is the drier. Then apply this principle directly to our own case, and note the importance of every means of catching storm water so that it may soak into the deeper soil and saturate it. Then the whole force of capillarity will be spent in drawing water upward toward the feeders of the growing crops.

CAPILLARITY ASSISTED AND EVAPORATION CHECKED.

What, then, can be done to assist this force, capillarity, in bringing ground water to the surface? Plow deep, pulverize well, and firm or compress the soil. A fine-grained compact soil attracts capillary water, while a coarse-grained, cloddy, or lumpy soil does not; but suppose this water is steadily drawn to the surface where it is exposed to evaporation, then occurs a great loss of moisture. How may this be checked? By loosening and pulverizing a few inches of the surface. This cuts off the capillary or hair-like passageways and stops the attraction of capillary water. This is called mulching the soil. It is a blanket or covering to shut the evaporation out and to keep the moisture in.

Digitized by Google

The field is rolled to compress or firm the soil; that is, to make it draw water to the crop. The top is raked or harrowed and pulverized as finely as possible so as to stop capillary water from coming to the surface to be evaporated.

The principle is too well known, and the practice too common to need further comment.

HYGROSCOPIC WATER.

There is also a third class of water in the soil called hygroscopic water, whose presence we would not suspect, yet if we take what is called perfectly dry earth and bake it, water will be liberated, just as is the case when sun-dried bricks are placed in the kiln and burned. This does not circulate in the soil, but adheres to the soil grains so intimately that it can be driven off only by high heat. This leads us to some forgotten facts respecting absorption and imbibition of moisture by the soil.

THE ABSORPTION OF STORM WATERS.

Soils will imbibe or absorb moisture according to their physical condition and composition. Compact clay soils absorb but little; so coarse-grained lumpy soil; light loose sandy soils absorb a great deal.

The hard-packed virgin prairie sheds water like a roof as compared with our cultivated fields which drink it in. A perfectly dry soil will absorb less moisture from a shower than a moist soil, a fact full of significance to Nebraskans, and one which is capable of application. Pour water upon a perfectly dry sponge and it absorbs but little of it, while the damp one will catch every drop. Pour water upon a dry ash heap and but little is absorbed. So it is with a dry soil, in which case, before water can be absorbed, a certain amount of air must be expelled. The dry soil particle offers but little attraction to the water compared with the moist soil grain.

Now for the direct application of this principle.

CULTIVATION TENDS TO CATCH AND HOLD MORE MOISTURE.

That field which is better cultivated is apt to contain more soil moisture conserved in it, therefore it is in better condition to imbibe or absorb water precipitated upon it, which is one important end to be attained by our agriculturists. Plow and cultivate, and thus render the ground more moist so that it can the more readily absorb storm water, then cultivate and mulch the soil so as to retain it.

DESIRABILITY OF CATCHING AND CONSERVING EVERY DROP OF RAIN.

Without a doubt it would pay well, even though disfiguring our pasture lands, to plow furrows every few yards in rolling fields, to check and help to retain for our soils every drop that can be absorbed. Every draw should have a dam thrown across it no matter whether it holds water or not. It will at least check the waste of storm water, which, if not arrested will flow out of the state. Suppose the pond so constructed does not hold

Digitized by Google

water well, what does it matter so long as this waste has been averted? Does not the water so caught soak into the ground to the benefit of the owner and his neighbors? Professor Whitney, of the U. S. Geological Survey, who has so carefully and critically studied the soil conditions in Nebraska and Kansas, lays stress on the importance of saving every drop of water that falls. That portion which flows off although amounting to but ten per cent is of no direct benefit to our agricultural interests, but would be if saved.

Professor Whitney in the Year-book of the U. S. Department of Agriculture for 1894 writes that "During a recent examination of the conditions in the soils of the plains of western Kansas and Nebraska and eastern Colorado, no trace of moisture was found in a number of borings from just below the surface to a depth of three feet under the natural prairie sod, except on the light sands of the sand hills near Garden City and in a few depressions where water had evidently been caught. The season had been extremely dry, but an inch of rain had fallen a week before the examinations were made. Where the sod had been broken and the land had been cultivated during the season the subsoil was quite moist, and the more moist the more thorough the cultivation had been. At Geneva, Nebraska, the soil and subsoil immediately under the prairie sod was so dry that it was extremely difficult to take a sample with an augur, both because it was hard to bore into, and because the material loosened by the augur was so dry and powdery it ran off the augur like fine dry sand. An oat field which had been thoroughly prepared by subsoiling two years before was still quite moist, although the ground had not been actually cultivated for two years.

In an adjoining field which had been subsoiled the previous year, and during the present year had been thoroughly cultivated, the subsoil down to a depth of three feet was so moist that it could be moulded in the hand. These three localities were not over a few hundred feet apart, and had been exposed to precisely the same rainfall, but had been subjected to these different methods of cultivation."

So much has already been said and written touching the relation of increased cultivation to the absorption and retention of soil moisture that the principle has come to enjoy general recognition. There is one local soil feature which must be mentioned.

CRACKS AND FISSURES IN OUR SOIL.

In regions overlaid by loess—that light yellowish deposit so generally known, often called the bluff-deposit on account of its tendency to break into vertical bluffs—it is of regular occurrence to find fissures, sometimes several inches across and many feet deep, traversing the prairie soil in all directions, thus increasing enormously the surface exposed to evaporation. In the severest weather of mid-winter and again in the continued droughts of summer these fissures are open. However, in cultivated regions this action is stayed or averted altogether.

Digitized by Google

RELATION OF PRECIPITATION TO IMBIBITION IN NEBRASKA SOILS.

In the outset it was mentioned that the prime element of fertility—moisture—is lacking in our soils. Perhaps this statement in the light of comparison with other states will bear qualification. While the rainfall of the state is less than that of eastern states, yet the amount absorbed is such as to about equalize things. For example, the rainfall of Nebraska for the past twenty years (from 1876 to 1896) as computed by Professors Loveland and Swezey is 23.33 inches, of which 2.33 inches, or ten per cent, is lost by flowing off, while twenty inches is saved by soaking into the soil. In the eastern states with an annual precipitation of thirty-eight to forty inches, fifty per cent or twenty inches is lost by flowing off in streams, leaving twenty inches to sink into the soil. This just about equalizes matters be-

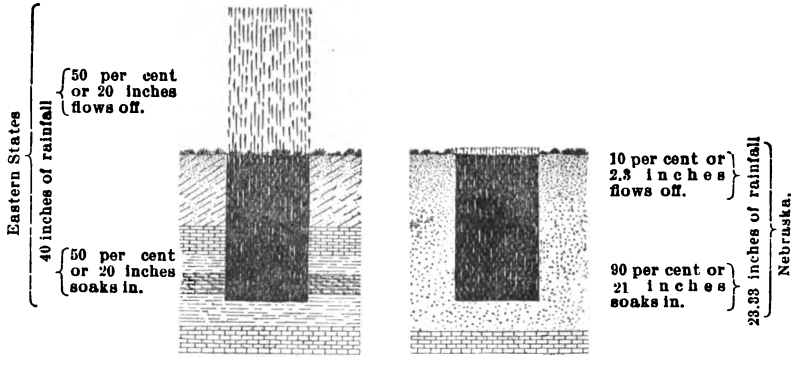
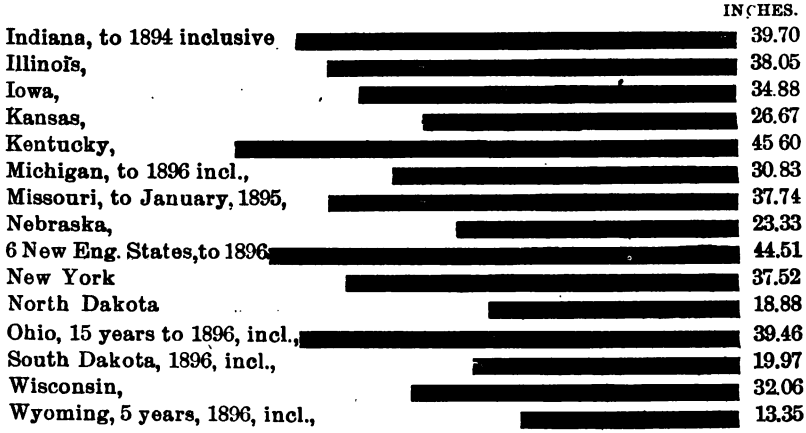

Eastern States
40 inches of rainfall
50 per cent or 20 inches flows off.
50 per cent or 20 inches soaks in.
10 per cent or 2.3 inches flows off.
90 per cent or 21 inches soaks in.
23.33 inches of rainfall
Nebraska.

FIG. 6.—Shows graphically the difference between the shallow clayey soil of the East and the deep sandy soil of the West. Though the eastern soils receive about twice as much rainfall, yet they imbibe no more than Nebraska, the rest flowing off, often washing the land badly, and carrying away soil fertility.

tween the East and the West and presents our state in a better light, and helps to explain how a flourishing and increasing agriculture has sprung up on the very soil where it was once pronounced impossible. In the New England states, which represent a total area nearly equal to that of Nebraska, the annual precipitation is about forty-four inches, yet the amount caught and held by the soil for plant food scarcely exceeds that in our own state. For the sake of comparison a table is introduced to show the annual rainfall in other states.

Digitized by Google

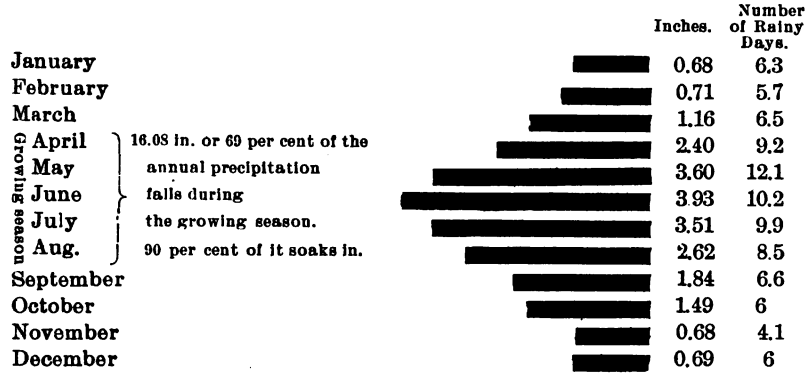
TABLE SHOWING THE ANNUAL PRECIPITATION IN NEBRASKA AND NEIGHBORING STATES.



RELATION OF PRECIPITATION TO THE GROWING SEASON.

But in still another respect is the unequal distribution of rainfall in the east and West equalized, and a compensation found in the fact that our rainfall, though a trifle scant, is most timely, for sixty-nine per cent or more than two thirds of it amounting to sixteen inches falls during the growing season, as is shown graphically in the subjoined table.

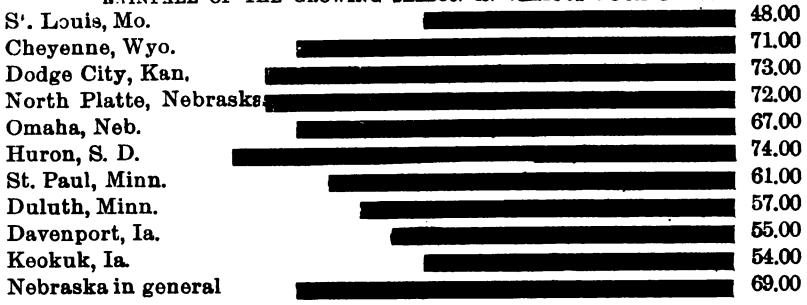
TABLE SHOWING THE MONTHLY PRECIPIPATION IN NEBRASKA.



Nebraska may feel just pride in the fact that such a large proportion of moisture is caught, and in the additional fact that it comes at the season when most needed. This is what enables Kansas and Nebraska to raise phenomenal crops (against which other states cannot compete) on a limited precipitation, so limited as to produce drought and complete crop failures in the eastern states.

Digitized by Google

RAINFALL OF THE GROWING SEASON IN VARIOUS LOCALITIES.



THE IMPORTANCE OF A MOIST SOIL.

The amount of water precipitated and that consumed by vegetation and growing crops can only be realized and appreciated after one has figured it out with pencil and paper.

One-fourth inch of precipitation per acre equals 28.3 tons of water.

One inch of water per acre equals 113 tons of water, in round numbers.

Two inches of water per acre (unusual precipitation) equals 226 tons of water.

Twelve inches of water per acre equals 1,361 tons of water.

Sixteen and eight-tenths inches received during our growing season equals 1,901 tons of water.

Twenty-three and thirty-three hundredths inches, the normal annual precipitation for the state equal 2,641 tons of water.

The above represents our receipts of water per acre, against which must be balanced the water which is disbursed to growing crops.

THE WATER NEEDED BY GROWING CROPS.

Plants will live on ninety tons of water per acre, but flourish on one hundred and fifty to four hundred tons per acre. When a crop is cured it weighs less than half what it did when green, while some plants retain but a fiftieth part of their original weight, when dry, which indicates the amount of water needed by the growing crops. Geologists in making approximate computations reckon about one ton of dry vegetation per acre as the annual production. The dry oat stacks on an acre, weighing, say, one ton, required for their production over five hundred tons of water. The fodder shocks on an acre required two hundred to three hundred tons.

A potato crop may make a draft of 1,000 or more tons of water per acre. Inasmuch as there is about 1,901 tons of water on deposit during the growing season per acre, the fear of an overdraft under ordinary conditions is not to be entertained. It is the long continued stringency of drought, or the short "run" of a hot wind, which wrecks the crop. The action of hot winds on vegetation is most disastrous. Heated often to 100 degrees, and

Digitized by Google

carrying a low percentage of humidity, sweeping over the state with a velocity of thirty to thirty-five miles per hour, the hot winds may blast crops within three or four hours.

When the temperature is high, if the wind is low, plants suffer less for very obvious reasons. The moisture taken into the circulation of the plant is breathed out through the mouths or stomata of the leaves. This soon forms a layer of moist air around the plant, thereby checking the excessive expiration, because of the incapacity of the moist envelope to carry more moisture. But let the wind constantly carry away the envelope of moist air, and renew it with air capable of carrying moisture as fast as the plant surrenders it, then the collapse of the plant is to be expected. One of the many objects in planting wind-breaks is to check or stay somewhat this effect of the wind.

WINDBREAKS PROTECT PLANT AND SOIL MOISTURE.

The planting of trees for fruit or for ornament or as windbreaks is to be constantly encouraged. As tree planting increases from year to year, and as more land is brought under cultivation so as to catch and hold that much more moisture, and as methods of conserving soil moisture are understood and adopted, our soil ought to improve in the amount of its moisture. This must not be confounded with the idea that the amount of our annual rainfall increases as more acres are brought under the plow, all of which is a mistake.

OUR ANNUAL RAINFALL NOT INCREASING.

As a matter of fact the rainfall now averages almost what it did twenty years ago, and Professor Swezey finds no ground whatever for the popular, but erroneous belief that the amount of our precipitation is increasing.

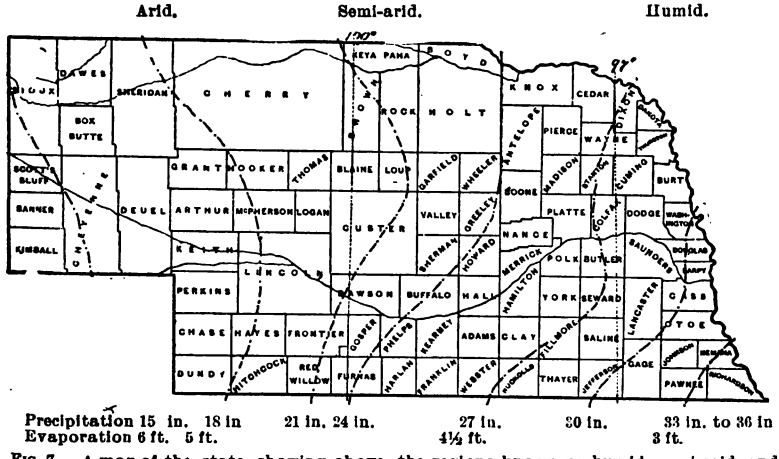


FIG. 7.— A map of the state, showing above, the regions known as humid, semi-arid, and arid; showing below, the precipitation and evaporation. The average precipitation is 23.33 inches per year. The average evaporation 4½ feet. [After Swezey and Loveland.]

Digitized by Google

With a limited rainfall attended by excessive evaporation, and with a supply of surface water barely sufficient for the irrigation of a thirteenth part of the state, whither may one turn for more moisture? There are several avenues of escape. One is by closer cultivation of the soil which serves the double purpose of catching and absorbing more storm water, and letting less of it evaporate away afterward. Another is by the impounding of storm water. A third is to draw on our ground waters for additional supplies. As soon as our available surface supply for irrigation is used then we must resort to the above. At present there are miles of great irrigating ditches flowing idly away awaiting the time when the growth of the country will put the water of these idle ditches to the use for which they were intended. One may view the growth and development in our irrigated regions, and quickly picture the time when our streams will be diverted into the mains and laterals of the irrigating ditch, leaving dry river beds as in Kansas. After this is done we still have at our disposal an inexhaustible supply of ground water, concerning which a complete knowledge remains to be gained.

GROUND WATER.

If rain in sufficient amount falls upon and soaks into our deep soil, it may become soaked and saturated with water. That is, there is more water there than it can hold. Accordingly the water begins to move or flow away laterally in all directions. This, at best, is a slow process. Nevertheless, the line of saturation, which is naturally subject to ups and downs, begins to slowly subside, and may fall so low that the springs and streams which have been flowing grow weak and eventually dry up, as do the shallower wells. This is called the ground water. It is the source of supply for our wells. It is common usage to speak of first, second, and third water, and sheet water. By first water is meant the first seepage which makes its appearance in the well. Second and third water is, doubtless, but the same thing struck at lower levels, where the amount is greater. Sheet water is but the same ground water struck in coarser material, which naturally furnishes water more freely, so freely, in fact, that it is reputed to be a different source of supply, and is honored with a different name. They are all to be counted as ground water, free water, or gravitation water, as it is called.

MEANS OF BRINGING GROUND WATER TO THE SURFACE.

Though our experiments in bringing water to the surface are but in their infancy, no state in the Union, as the author confidently believes, can show water lifting devices of such numbers and variety, of such originality and ingenuity as Nebraska. As we travel from farm to farm and visit these important creations of the inventive genius of our farmers—a genius greatly stimulated by several recent years of drought—the subject grows in magnitude and significance until it must be embodied in a separate report. Simplicity is the highest attainment in the art of invention, and the very embodiment of this is found on some of our farms where

Digitized by Google

water has been brought to the surface in this simple way: two or three kerosene barrels, set end to end, after being nailed and cemented together,

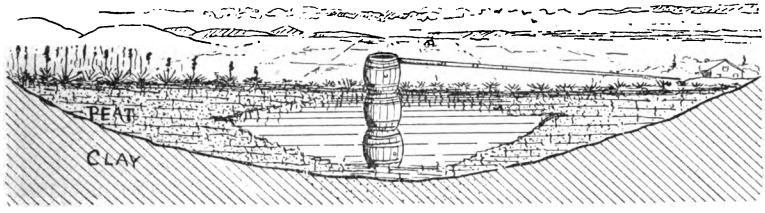


FIG. 8.—A sectional view of an "Artesian Spring" in a boggy spot in Richardson county, which the owners utilized in a very simple way by cementing kerosene barrels together, and conducting the water away in pipes. Water rose in the barrels some two or three feet above the surface and flowed readily by its own weight to the house.

were sunk in a boggy spot where water showed a tendency to well up to the surface. A gas pipe was conducted thence to the fields where the water was needed for stock or irrigation. Without additional outlay, this admirably simple device did its work uninterruptedly for years. We have seen similar devices furnishing spring water for domestic use as well as for the stock and the irrigation of the truck patch.

In making the survey of the state the author constantly comes in contact with similar displays of an intelligent use and development of a natural resource. In the western part of the state, where homes are often advantageously located at the base of lofty buttes and table lands, the farmers find the water seeping out at the base of a sandy layer overlying the white river clay. Taking advantage of this circumstance, they dig back a

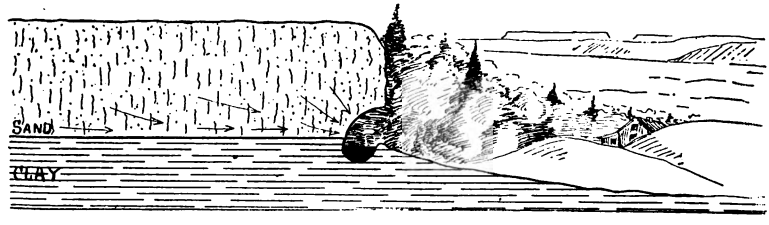


FIG. 9.—A section in the butte region of western Nebraska showing a layer of permeable sand overlying impermeable clay. The direction of the arrows indicates the course of seepage water. By digging clamshell caves as shown in the cut, citizens obtain, without cost, considerable water for domestic use and for stock.

few feet, making a shallow cave, thus broadening the surface for seepage to such an extent that it yields a liberal supply of fine pure water for house use and for the stock. Sometimes the water from these seepage caves is conveyed by means of wooden troughs to the milk house, then to the horse trough, thus doing double duty. About 100 miles north of these we found a similar cave-well at the base of the precipitous wall of Sow Belly canyon in Sioux county. After passing the water through the milk house, the owner conceived of the idea of driving the water up a small hill to his house and beyond to his barn by means of a small water ram. The

Digitized by Google

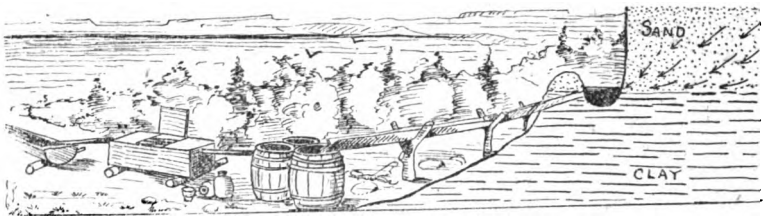


FIG. 10.—Showing a "dug-out" spring similar to that in Fig. 9, but more elaborated. Here the seepage water is conducted by troughs to barrels, thence through the milk box to the watering trough.

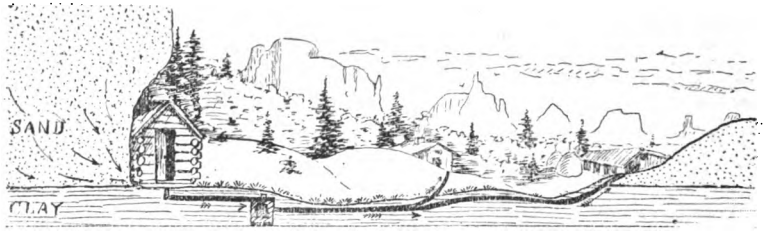


FIG. 11.—A "dug-out" spring in Sowbelly canyon, Sioux county, Nebraska, utilized to supply the milk-house, thence the water flowed into a water ram and was forced to the house and barn.

plan worked admirably. It supplied more water than was needed by the family and stock, and yet the excavation was not deeper than four or five feet and eight or ten feet across, and cost nothing but labor. This is commended to the attention of citizens living in butte regions of the state, where advantage of such seepage water may be taken.

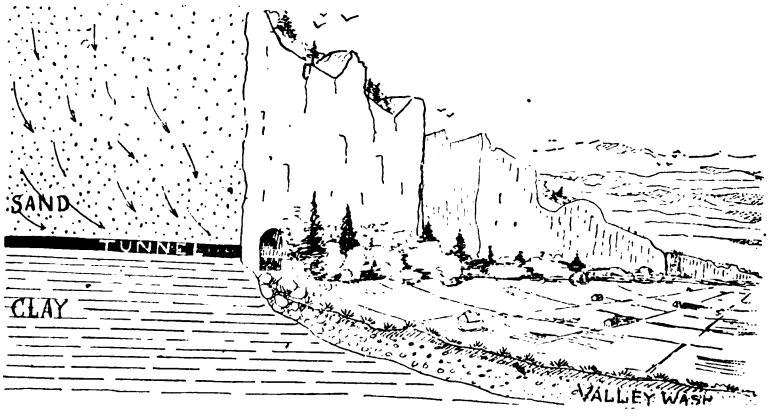


FIG. 12.—Showing a section and perspective view in the butte region of Sioux county, at Pine Ridge. Should tunnels be cut along the line of contact between the sand and clay layers, it seems reasonable to expect a sufficient flow of seepage water for considerable irrigation, as suggested by the cut.

Digitized by Google

This spring was some 400 or 500 feet below the extensive table land. Along this level for miles there is the same seepage streak which helps to feed numerous springs and small streams leading into the Hat Creek basin. Should this work of excavation go farther, at the instigation of private or public enterprise, and should a tunnel be dug several hundred feet or more in length, instead of a shallow clam shell cave, undoubtedly it would expose such a broad surface for the escape of seepage that considerable volumes of water could be obtained. The amount would vary, of course, with the size and length of the tunnel. The expense, too, would not be great, for the sand is but feebly consolidated into rock, which yields rapidly before the pick and shovel. Conditions identical, or very similar to this, occur throughout the western tier of counties from north to south across the state, which makes it all the more desirable that a test be made of the practicability of this apparently feasible plan. A somewhat similar method is in practice in some localities, especially in the sand hill regions, where there are often numerous swamps and small lakes. Storm water seeps through the sand with a rather rapid rate of delivery, rendering it a simple matter to get an ample volume of water by tunneling back

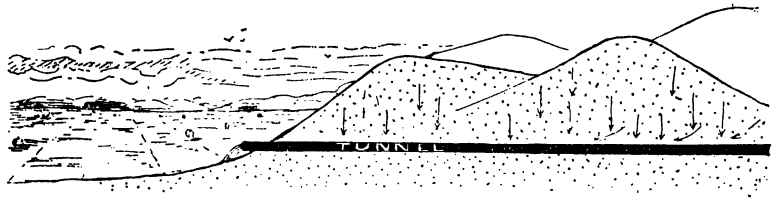


FIG. 18—An ideal view showing the tunneling into the seepage waters of the sand hills, as practiced in Rock county. Considerable volumes of water for irrigation may be obtained in this way. This, if conducted through board flumes, would not be lost by sinking into the bed of the sandy ditch as at present. This represents one of the many attempts to utilize our water resources.

a sufficient distance into the base of the hills. In practice, however, it is found that water in the sandy ditch soaks in and is lost. This is easily remedied by conducting the water through board flumes as is so commonly done. Since water has come to have such marketable value among the irrigationists of Colorado, Wyoming, South Dakota, Nebraska, and Kansas, it is plain that the enterprise is worth the lumber required.

This method seems practicable and relatively inexpensive, and inasmuch as it is applicable to a large region it is commended to the consideration of those interested in such matters.

There is another method of still wider applicability; that is the tapping of the underflow of streams. A river bed may be dry, and yet its coarse sand and gravel may be saturated with water. This may be brought to the surface by tunneling back under the river bed a sufficient distance to get the required amount of fall. In Kansas where some of the rivers have been completely diverted into the irrigating ditches of Colorado, leaving the old river bed dry, admirable results have been obtained by this method. In one case a Kansas farmer, after tunneling into the underflow

Digitized by Google

of a dry river, a distance of 1,300 feet at a cost of about $1,300, obtained a fine, steady stream of water, which in volume exceeded that from a neighboring pumping plant which cost $60,000. This meant a fortune for its projector, and it is said to have set him upon his feet the first season.

FIG. 14.—An ideal section through a river valley, showing the old channel well filled with gravel and sand, with the present river flowing above. Through the sand and gravel there is a strong underflow of water. In some cases this is successfully tunneled into and drawn off for irrigation.

This is a source of such unlimited stores of water that it seems worth while to describe the underflow water more in detail. We have but to see the Platte river to form the opinion that it is gorged with sand. In fact, we find it a set of interlacing channels flowing around innumerable great islands of sand. Not one broad river, such as everyone is familiar with. It is plain that its load is more than it can carry, and instead of transporting it out of the state about the best it can do is to shift its sand from side to side. But all the while it is receiving fresh additions of silt, sand, and gravel from its higher sources. This means that it is building up its bed, and has even raised it above the surrounding country in some places.

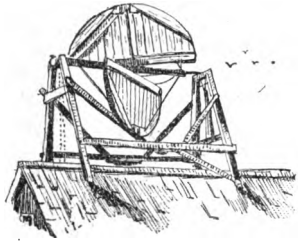
It is supposed that the sands of the Platte River are as much as 200 to 300 feet thick in places. This is coarse material and naturally one through which water percolates freely, that is, it is one of rapid delivery of water. It is apparent that the underflow water is far greater in amount than that in the channel proper. This inexhaustible supply may be drawn upon with great freedom, by the gravitation method already described, where the water flows by its weight, or it may be raised to the surface by any of the many pumping or water lifting devices.

WINDMILLS AND WATER LIFTERS.

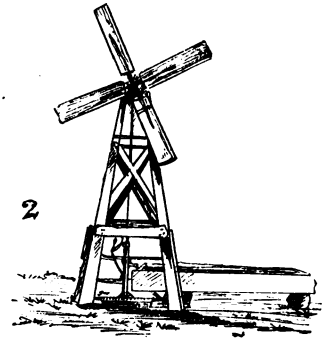
Heretofore only gravitation methods have been considered. But it isn't every farm that is so favorably situated that water will flow upon it by its own weight. Then recourse must be had to the pump and elevator. These are of divers patterns and makes, and the motive power for operating them may be steam, gasoline, wind, or horse power. Passing from the gravitation methods we soon cross the line and begin to approach the point where the expenses equal the profits; that is, it ceases to pay. However, this is an important means of irrigation and one which is growing rapidly in favor, and is even spreading eastward.

Where the wells are shallow each or any of these forces may be used profitably in lifting water, either for domestic use and herds, or for irrigation. Where the depth to water reaches 75 to 80 feet, irrigation therefrom, becomes a doubtful enterprise. This is about the limit to which water can

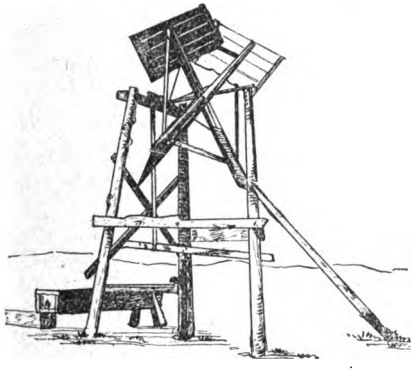
Digitized by Google



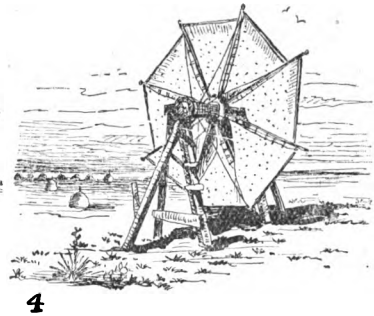
1



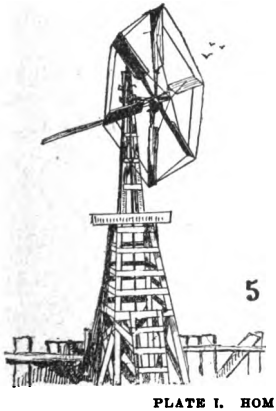
2



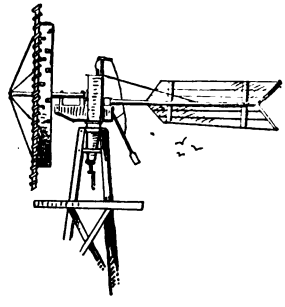
3



4



5



6

PLATE I. HOME-MADE WINDMILLS OF THE TURBINE TYPE.

FIG. 1.—A two-fan turbine near Ashland, Neb. FIG. 2.—A four-fan turbine near Grand Island, Neb. FIG. 3.—A four-fan turbine near Overton, Neb. FIG. 4.—A powerful eight-fan turbine mill, "The Defender," with duck sails. FIG. 5.—A six-fan turbine mill and tower at Ogalalla, Neb. FIG. 6.—A turbine mill at Newport, Neb., made of the driving wheel of a reaper and the thimble of an old wagon wheel. Cost, $6.00; pumps 12,000 gallons of water daily.

Digitized by Google

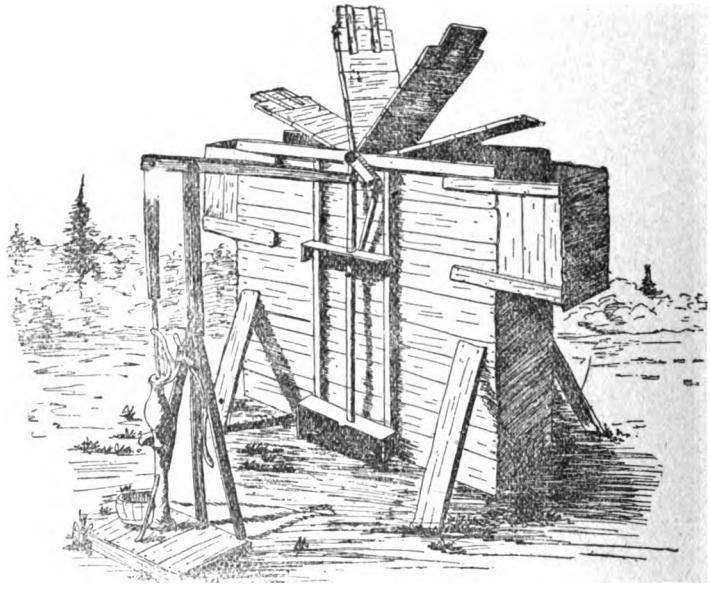
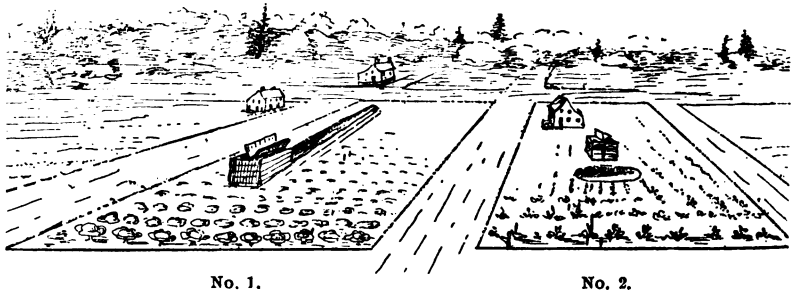


FIG. 15.—A remarkable little Jumbo, designed and built by Mr. J. L. Brown, proprietor of the Midway Nurseries, at Kearney, Nebraska. It cost but $1.50, yet it pumped sufficient water to irrigate and save the garden truck, the strawberry patch, and the small fruit during the most trying season of drouth ever recorded in the state. Box three feet wide, nine feet long, six feet high. Eight fans, three feet wide by four and one-half feet long, supported on a gas-pipe axis.

be lifted profitably for irrigation. Fortunately the underflow water is near the surface and the shallow wells increase the chances of profit by this method of irrigation. Here the windmill is employed to good advantage, and there has sprung up along the Platte Valley a series of mills, both shop-made and home-made, which for numbers, variety, and originality of inventive genius stand unrivaled. The shop-made mill is plainly the one to be preferred, but there are many who cannot afford such a mill in the start; still they can afford the time during unemployed hours



No. 1. No. 2.

FIG. 16.—Market gardens of the Travis Brothers, Lincoln, Neb. Mill No. 1 cost $8.00, irrigates 5 acres. See figure 17. No. 2 cost $11.00 and irrigates 3 acres. Reservoir of No. 1 about 150 feet long by 4 wide, by 2 to 3 feet deep.

Digitized by Google

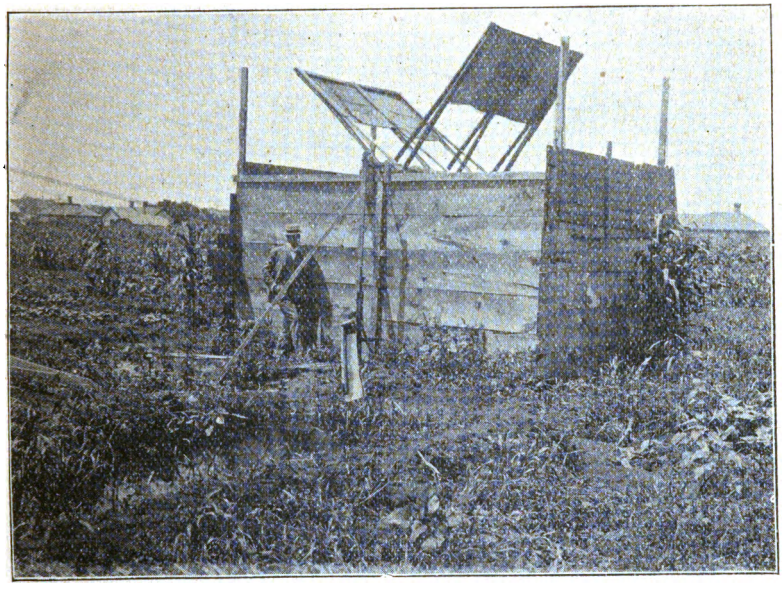


FIG. 17.—Jumbo windmill of the Travis Brothers, market gardeners, Lincoln, Neb., showing edge of reservoir 150 feet long by 4 feet wide; size of mill 9 feet wide, 13 feet long, 13 feet high. The cut-offs with guide ropes and pulleys for raising and lowering may be seen at either end. The sails are of burlap. Cost of mill $8.00. Irrigates five acres sufficiently for all the needs of the market gardeners,

to build one. It has been gravely charged that a man of this type is probably a poor, shiftless, and undesirable citizen, and that it is unfortunate rather than otherwise that the people of this class should be informed how to make such mills, which may enable them to subsist instead of suffering them to be driven from the state. The author finds this assertion totally unwarranted, and finds that the man with the ingenuity to design and build a mill is the man whose gates and doors shut, whose locks lock, whose farm, house, and outbuildings, though cheap, are in good repair, and around whom there is an air prophetic of future prosperity.

There are many hundreds of these home-made mills in the state, all differing more or less to suit the caprice of the builder, but all agreeing in this, that they do their work well and give satisfaction to their owners, and are so cheap that one may own several such mills. Furthermore, it is the avowal of many that the profits arising from the windmill during the late period of drought often exceeded those of the entire farm. However modified, these wind engines may be divided conveniently into three classes: turbine mills, jumbo mills, and merry-go-round mills. The turbine mills so closely resemble the shop-made ones as to be mistaken for them. In fact, it is a practice with some shrewd farmers to remodel old, discarded, or injured turbine mills. The author has seen such mills, which cost but $10 for a ten foot steel mill reconstructed to look and

Digitized by Google

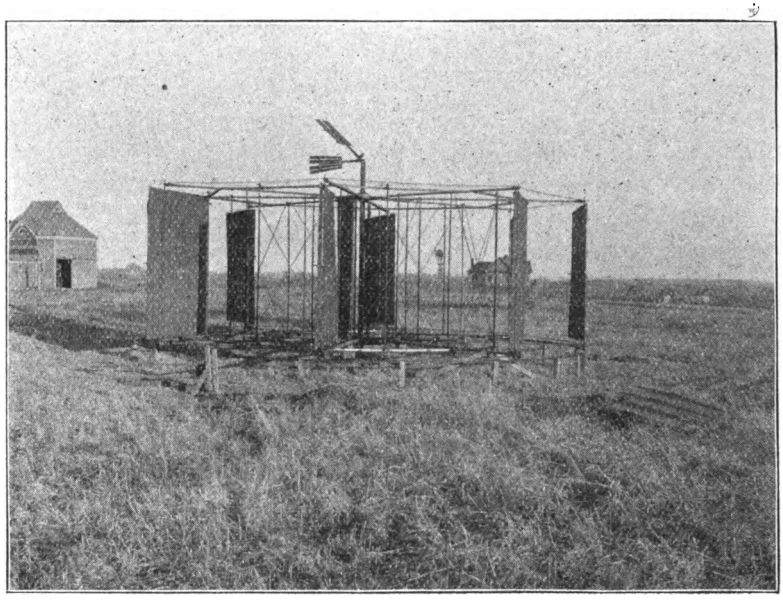


FIG. 18.—A "Merry-go-round" mill, Lincoln, Nebraska. An attempt to design a mill of unlimited size and power, diameter of mill forty to fifty feet, height 12 to 14 feet. Designed by S. S. Videtto.

work as well as new. Examples of such reclaimed mills are to be found in nearly every county. Some farmers have converted the sprocket wheels and chains of discarded binders into open faced or turbine mills which worked well, at a cost varying from $3 to $5. The commonest home made mill is the jumbo, because it is at once cheap and easily made. The cost of such mills will average about $5 to $6. Some cost nothing whatever save labor. Though mills of low efficiency they do an important work in raising water for the irrigation of garden truck, orchards, and small fruit. A remarkable little jumbo, which cost but $1.50, pumped water enough for the successful irrigation of the garden, strawberry patch, and small fruit of the Midway Nursery at Kearney during the worst period of drought known in the history of the state. Some of these mills, such as the Tannahill mill, near Columbus, are engines of sufficient power to drive two large pumps and irrigate eight to ten acres successfully. These mills might be arranged in gangs to good advantage; they might be placed upon cribs and out buildings, thus avoiding the expense for considerable lumber.

During the summer of 1897 the author sent three students, at his own expense, twice across the state, to examine and report upon the windmill as a factor in irrigation, and it was not an uncommon thing for them to find eight or ten novel home-made mills in a community. It is more than ever apparent that the home-made mill is a factor of growing importance

Digitized by Google

to our agriculture. Some designers have undertaken to construct mills of unlimited size in order to lift more water. These may be called the merry-go-round type of mill. Some are so large that the fans run on wheels mounted upon a circular track.

In addition to these water lifters, one sees horse power, steam, and gasoline in use. The Platte valley is the arena for such work because the shallowness of the wells increases the chances for profit from irrigation. Where the supply of water is at all limited, farmers dig wells close together and connect them in gangs, in this way furnishing more water than the largest steel mills can exhaust.

THE STORAGE RESERVOIR.

The storage reservoir may be built of wood, metal, or of the soil and subsoil of the place. Suburban residents, market gardeners, and small fruit growers often find it advantageous to use the shop-made tank, which may be had of almost any desired size and at prices varying from $10 to $1,000, if need be. Certain farms lie so nearly in a level plane that their owners are compelled to have their reservoirs mounted high enough to give the desired head or pressure, so that the water may be forced to the end of furrows instead of soaking in before it goes half way across the field.

The common reservoir, however, is that built by scraping out and banking up the earth on some elevated portion of the farm. However, it must never be forgotten that the commonest way of doing a thing is not necessarily the best. Examination reveals the fact that the builders of these reservoirs often ignore inviolable laws, and set the principles of mechanics and mathematics at variance, the result being that one man's reservoir may cost twice as much money and labor as another man's of the same capacity. The circular reservoir is the form which has the greatest capacity for the amount of embankment, while the long narrow reservoir is the one which goes to the opposite extreme. We see more square or rectangular reservoirs than circular ones. The laws of seepage and evaporation are often likewise ignored, leading to disappointment, discouragement, and loss. The reservoir in western Nebraska—where the evaporation is six feet—which is 100 to 150 feet in diameter, and five to six feet deep, will dry up in a few months, while, at the same time, a neighboring pond which is half as wide and twice as deep will lose scarcely more than one-fourth of its water. We have seen reservoirs 150 feet long, four feet wide, and three feet deep. This is a large amount of embankment for a small amount of water. Some take pains to build oblong reservoirs with the short diameter north and south, that is, in the direction of the prevailing wind, so that the wash of the waves may not tear down the bank. Where the lay of the land is right, one of the most sensible and economic reservoirs is made by throwing an embankment across some draw. One acre of reservoir is often allowed to every seventy-five to one hundred acres of land.

In talking with practical men, it seems that there is some difference of opinion on every point. However, in the construction of reservoirs there are certain practices in general favor. The average of a considerable num-

Digitized by Google

ber of our reservoirs will show about the following results: depth of water, about four to five feet; diameter of reservoir, roughly, one hundred feet—this is about the right size of pond, large enough for the irrigation of eight to ten acres;—embankment twice as broad at the base as it is high. Where it is possible to choose a well-elevated spot for the location of the reservoir, it is the common practice to plow and scrape out the bottom to a depth of two or three feet, piling up the earth thus removed into an embankment two to three feet high. See Fig. 19.

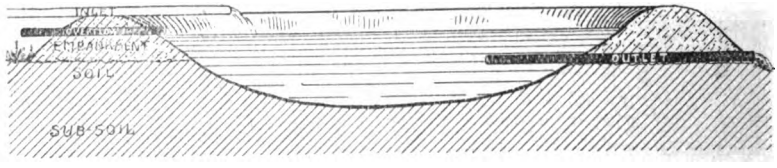


FIG. 19.—The commonest type of irrigating pond in Nebraska. Here the embankment was made of the material plowed and scraped out of the pond site. This is a less desirable form than that shown in Figs. 20, 21.

There are two main objections to this method: first, it holds less water; and, second, it lowers the reservoir some two or three feet, whereas it ought generally to be raised. Other farmers build on the following plan, which is probably better.

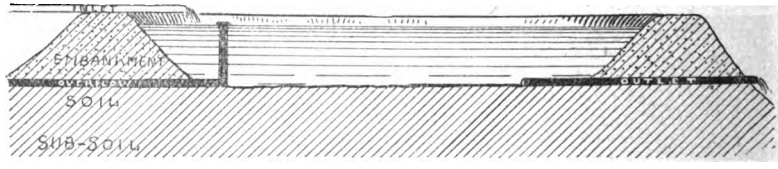


FIG. 20.—A form of reservoir recommended for level lands. This reservoir gives the water greater head so that it will flow to the end of the furrow before soaking in. At the same time the cubic content is greater than in Fig. 19, which is the commoner type of reservoir.

The sod is plowed up, and by some removed entirely from the area to be covered by the pond. It is recommended that the sod be removed for the embankment at least.

This done, earth is scraped from without the reservoir—not within it—and piled up to make a wall or embankment four or five feet high and sixteen to twenty feet at the base. This method of construction is greatly preferred by those whose land is level. A reservoir will hold water better if it is in a clay soil, which is practically impermeable, if well made. It is apt to leak badly at first in a permeable sandy soil, such as ours, unless very well made. To check this leak many wet the reservoir and tramp it into mud eight or ten inches deep by driving horses and cattle around in it. If this is continued at intervals until the soft mud gradually grows less plastic, and finally hardens and packs, it is apt to give encouraging results. Some take pains to carry this process of puddling into the embankment

Digitized by Google

by building it up six or eight inches at a time, wetting and tramping it down.

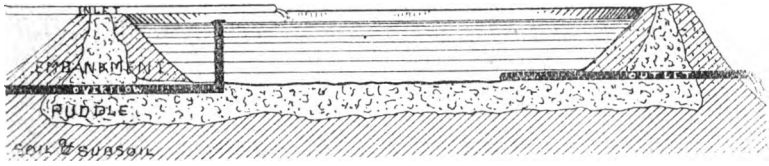


FIG. 21.—A section across an irrigating pond showing the bottom and the embankment puddled in order to hold water better.

Some build their reservoirs, not by the number of acres to be irrigated or by any other rule, but simply plan to have them large enough to hold all that the pump can discharge into them for a week or ten days at a time.

The great hope for reservoir irrigation lies in the fact that it is not often needed. But, when needed, there is no time for delay. The well-filled reservoir is emptied upon the field to tide it over a threatening week of drought, a recurrence of which, before the reservoir can be filled, is not at all likely.

The author is greatly pleased to report that he has seen farmers with such ponds well stocked with fish; that he has seen them built on a scale large enough to demand the service of two, three, or more mills to fill them. These were put to a double purpose, often furnishing water for irrigation in summer, and an ice harvest in winter, some even supplying ice to neighboring towns. But inventive genius has not stopped with the windmill as the only water lifter, for there are innumerable devices for attaining that end by other means.

Along the banks of some of our streams may be seen water lifters of sorts and kinds too numerous for consideration in this paper, one of the most efficient forms being that of the chain and buckets, run by horse power, steam, or windmill, as deemed best. Where there is a good current it is not an uncommon thing to see the great current wheels lifting water twenty-five to thirty feet high and discharging it into a trough.

The water of rivers is easily and cheaply raised above the bank as is the underflow water of their valleys; but such conditions exist over a small portion of the state. The balance must draw its supply of water from common wells, that is, from the ground water, which is an inexhaustible source of supply in Nebraska. Unfortunately, in some regions the depth to water is such as to render irrigation from this source a doubtful enterprise. In other cases the depth is such as to preclude the possibility of profit, notwithstanding the fact that there are people in every community who insist on the contrary.

SUMMARY OF THE WELLS OF THE STATE.

Basing our judgment upon the well reports which have already been received, and holding it open to correction when full data are at hand, the following will probably represent our wells.

Digitized by Google

Barring exceptional localities there is an unlimited supply of well water of excellent quality over the entire state. Correspondents are generally enthusiastic in their praises of the quality, quantity, and constancy of the well water of Nebraska. The cost of digging is moderate, because of the depth of the soil, which makes it unnecessary to dig into bedrock. This loose material is removed with dispatch and economy. The average depth of wells for the whole state is about 100 feet, and the average cost about $60 to $65. All this is summarized as follows:

SUMMARY BY COUNTIES SHOWING THE DEPTH AND COST OF WELLS.

County.	Average Depth.	Average Cost.	Exceptional Depth.	Exceptional Cost.
Adams	122 feet	$ 80	1360	$4500
Antelope	100	50	305	170
Banner	42	35	262	250
Blaine	54	48	135	110
Boone	124	96	320	208
Box But e	154	93	247	123
Boyd	25	23	760	1500
Brown	44	23	181	200
Buffalo	43	34	190	160
Burt	66	50	....	....
Butler	71	43	290	200
Cass	35	39	500	750
Cedar	318	146	600	400
Chase	150	72	500	500
Cherry	107	80	255	192
Cheyenne	154	127	258	173
Clay	89	42	165	272
Colfax	59	50	167	170
Cuming	70	53	123	....
Custer	155	100	300	220
Dakota	82	78	186	130
Dawes	121	81	237	143
Dawson	204	179	274	215
Deuel	124	140	285	325
Dixon	118	73	445	....
Dodge	59	44	304	304
Douglas	124	311	1450	5663
Dundy	119	51	256	110
Fillmore	106	55	229	170
Franklin	172	55	210	75
Frontier	174	85	310	140
Furnas	104	68	287	160
Gage	64	63	1250	....
Garfield	118	62	258	210
Gosper	175	105	327	245
Grant	60	29	450	225

Digitized by Google

County.	Average Depth.	Average Cost.	Exceptional Depth.	Exceptional Cost.
Greeley	63	49	102	51
Hall	47	25	110	45
Hamilton	100	47	139	111
Harlan	83	35	188	100
Hayes	63	38	239	75
Hitchcock	83	23	190	70
Holt	57	37	117	68
Hooker	127	86	1200	....
Howard	63	43	165	30
Jefferson	137	28	200	180
Johnson	70	50	400	561
Kearney	118	74	197	83
Keith	97	76	413	636
Keya Paha	88	36	230	160
Kimball	150	93	460	750
Knox	170	142	656	3500
Lancaster	58	49	323	323
Lincoln	171	87	300	195
Logan	163	129	318	200
Loup	76	39	137	69
Madison	91	69	335	....
McPherson	92	35	264	150
Merrick	33	14	1700	8000
Nance	59	39	270	150
Nemaha	75	68	287	310
Nuckolls	66	31	535	....
Otoe	96	90	216	....
Pawnee	98	109	311	249
Perkins	180	144	282	239
Phelps	150	78	250	125
Pierce	64	59	182	150
Platte	100	71	580	350
Polk	104	56	214	150
Red Willow	153	63	405	200
Richardson	72	82	243	300
Rock	102	47	226	60
Saline	81	45	246	210
Sarpy	70	85	1456	500
Saunders	80	62	245	200
Scott's Bluff	57	42	330	200
Seward	108	56	346	246
Sheridan	71	57	195	150
Sherman	72	42	199	150
Sioux	176	87	320	....
Stanton	97	70	325	250

Digitized by Google

County.	Average Depth.	Average Cost.	Exceptional Depth.	Exceptional Cost.
Thayer	108	71	725	....
Thomas	128 ?	50 ?	....	....
Thurston	65 ?	39 ?	....	....
Valley	55	33	210	80
Washington	65	59	290	290
Wayne	35	19	124	50
Webster	80	37	380	....
Wheeler	132	50	935	300
York	94	94	590	250
Approximate average for the state	100 feet	$64	392	$517

Passing from the shallow wells of the valleys to the ordinary well of the plains, we come to that important and desirable class—the artesian well.

ARTESIAN WELLS.

Any well in which the water overflows is an artesian well, and in this fact lies the chief importance of the well, because there is no expense incurred in bringing water to the surface for domestic use or irrigation. There are several important artesian basins where a well at a given depth is sure to find imprisoned water. In this connection we may divide such wells into three groups, as follows: the shallow wells of Seward, Johnson, and Holt counties, the moderately deep wells of northeastern Nebraska, and the deep wells of Omaha, Lincoln, Beatrice, and adjacent regions. The artesian basin of Holt county is probably more than fifty miles long. Here flowing wells may be had at depths varying from forty to one hundred feet. Some are sanguine enough to believe that when this resource is appreciated and developed it will be the making of this large county.

At Beaver Crossing, in Seward county, is found another artesian basin about twelve to fifteen miles in length, which bids fair to be a very important one. At an average depth of about 100 feet water is struck, which rises with a sufficiently strong head to throw a steady stream ten to twelve feet above the surface. There are more than 100 wells already drawing water from this pent-up reservoir.

On one model farm there are nine such wells, which fill great irrigating reservoirs sufficient to irrigate 100 to 150 acres, the total cost of the nine wells being about $900. Unfortunately, many wells in this region have been allowed to flow away unused night and day, winter and summer. However, recent legislation will doubtless restrain this useless prodigality.

FROM THE NEBRASKA IRRIGATION LAWS, 1897.

SEC. 16. **[Wasting mutual artesian water.]** That it shall be unlawful for any owner or owners, lessee or lessees, occupier or occupiers, foreman or superintendent of any farm, town lot or other real estate in the state of Nebraska, where artesian water has been found or may be found hereafter, to allow the water from wells, or other borings or drillings, on any farm, town lot, or other real estate in Nebraska, to flow out and run to waste in any manner to exceed what will flow or run through a pipe one-half of one inch in diameter, except where the water is first used for irrigation, or to create power for milling or other mechanical purposes. [1897, Chap. 84, § 1.]

Digitized by Google

SEC. 17. [**Same—Penalty.**] Any person or persons who own, occupy, or have control of any farm, town lot, or other real estate in the State of Nebraska, who fail or refuse to close or shut off any wastage of artesian water to the amount that this act allows on any farm, town lot, or other real estate which they own, occupy, or have control of, after being notified in writing by any person having the benefit of said mutual artesian water supply, within forty-eight (48) hours after such notification shall be subject to arrest, and upon conviction be fined in any sum not less than ten (10) dollars nor more than twenty-five (25) dollars, and pay the costs of such arrest and prosecution for each offense; and if such wastage be not abated within twenty-four hours after such arrest and conviction, it shall be deemed a second offense against the provisions of this act, and be subject to the same fine as for the first offense. And every like offense or neglect of each twenty-four hours thereafter shall be deemed and considered an additional offense against the provisions of this act.

SEC. 18. [**Same—Prosecutions.**] All prosecutions under the provisions of this act shall be brought by any person in the name of the people of the state of Nebraska against any person or persons violating any of the provisions of this act, before any justice of the peace of the county in which such violation is alleged to have taken place, or before any court of competent jurisdiction.

At Cook, in Johnson county, there is a similar region where artesian wells are so easily dug that they are not fully appreciated, and are not put to their full use. To put it positively, they are abused, and valuable water goes to waste. Worse than this, it is so simple a matter to dig these wells, that many discard wells in a given field, to dig a fresh one elsewhere, and pull up the tubing, leaving the water to flow on up through the drill hole enlarging it indefinitely and saturating the subsoil.

The excuse for such prodigality is that the supply is inexhaustible. But this is not true. Every well drilled weakens the pressure to that extent. These wells, when properly used, will help to enrich the county. The Holt county basin is considerably more extensive and destined to be of greater importance probably These shallow artesian wells vary from forty to 100 feet, and cost, according to present reports, less than fifty cents per foot. To have water brought to our houses without cost or labor is a privilege worthy of high esteem.

The northeastern artesian basin extends over Knox, Cedar, and Dixon counties, being perhaps the most important artesian region in the state.

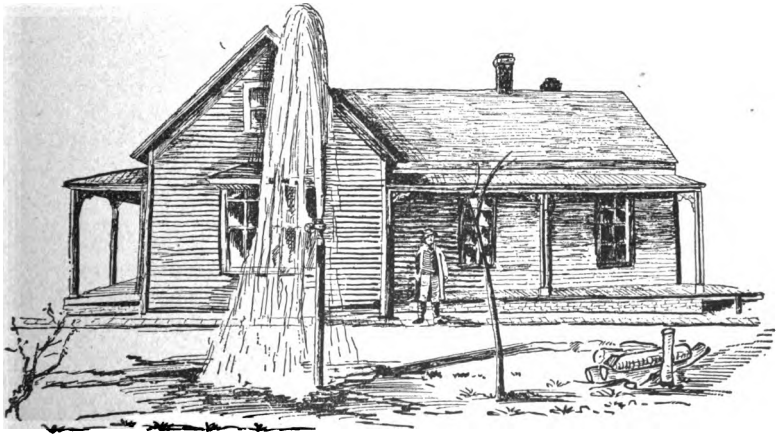


FIG. 22.—Artesian well near Niobrara, Knox county, Nebraska, on the farm of Mr. B. Bade. The 2½-inch pipe is choked down to 1½ inch, and the head, or pressure, is sufficient to throw a stream above the house top. Such wells are of growing economic importance, and the water of artesian basins should be husbanded. See laws relating to artesian waters, page 226.

Digitized by Google

These are wells of moderate depth, those reported from Knox county being much deeper than those of Cedar county, the average depth being about 600 feet, and the average cost about $3,500.

The average Cedar county well is about 325 feet, the average cost $116, or about 35 cents per foot. The conditions here are entirely different from those described before. This region is really a southern extension of the famous James river and Missouri river artesian basins of South Dakota, probably one of the finest regions known. The accompanying diagram may assist in explaining the existing conditions along the northern border of the state. Here it is plainly seen that the surface around the James and Missouri rivers is so lowered that wells pierce the sandstone, called the Dakota cretaceous, the finest water-bearing stratum in the great plains. It will readily be seen that this stratum dips down, then steadily rises toward the Black Hills and the Rocky Mountains. It is also to be noticed that this porous water-bearing bed is overlaid by impervious shales, and underlaid by impervious rocks. That is, the water which soaks into it on the lofty slopes of the Hills and Rocky Mountains is tightly enclosed and flows through it under heavy pressure. Accordingly, when tapped, the water rushes to the surface, sometimes throwing a stream high into the air. The deep artesian wells at Omaha, Lincoln, and Beatrice pass entirely through this layer and enter the carboniferous. In the city of Omaha at the level of the river, artesian water is to be had at the depth of 800 to 1,000 feet, having sufficient head to throw it fifteen to forty feet above the surface. In the higher parts of the city the same water may be struck, but the head is not sufficient to bring it to the surface.

The water of such wells is slightly saline and has a temperature of sixty-two degrees, which is eight to ten degrees warmer than ordinary well water, rendering it unfit for many uses to which it might otherwise be put.

OMAHA AND DOUGLAS COUNTY WELLS.

Name of Well.	Size of Pipe.	Depth.	Capacity per 24 hours.	Remarks.
Courtland Beach Well.....	6 inches	998 ft	86,000 gal	Raises water to a heighth of 40 ft.
Willow Springs "	6 "	1,800 "	.....	Cost $6,089.
The Miller "	0 "	1,303 "	1.158,000 "	Cost $6,500.00.
The Pickard "	.....	1,383 "	.....	....
Riverview Park "	4 "	1,064 "	114,427 "	....
The Exposition "	4 "	1,140 "	44,200 "	....
Elmwood Park "	.....	1,850 "	.....	Rises within 7 feet of surface.

The Lincoln and Beatrice basins are probably but continuations of the Omaha artesian basin, for all penetrate about the same water bearing layer. Doubtless the intervening places would show flowing wells if they were dug.

The first flow is found at a depth varying from 300 to 500 feet according to the locality. From this point down the flow continues, though growing little or no stronger, and the water varies from the brackish to that which is very salt. The southeastern counties are carboniferous, and all the deeper wells, and even the surface wells here are apt to be saline

Digitized by Google

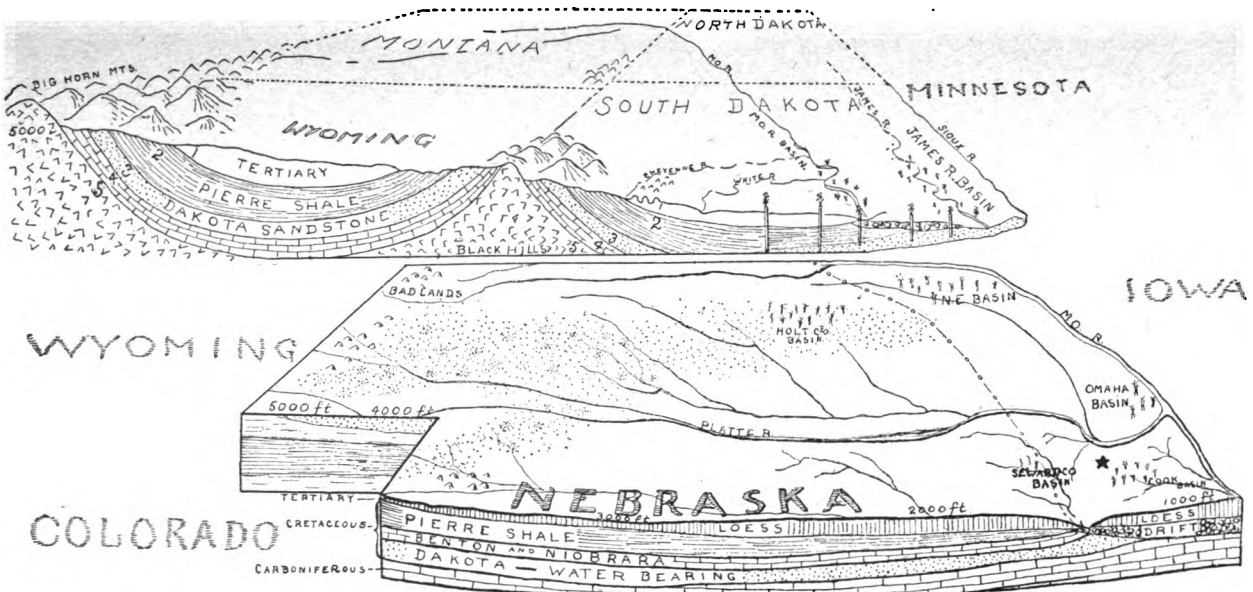


FIG. 23. **Geological section across** the southern boundary of the State, **and across South** Dakota, showing the order of the **strata. The Dakota cretaceous is the important** water bearing bed of the plains. The artesian wells of South Dakota and Northeastern **Nebraska draw their supply from this source. The** western limit of glacial drift is indicated by a broken line. The sand hill region is indicated **by stippling; the bad lands by hills; the artesian** basins are named upon the map; elevations are shown along the southern boundary of the **state. No. 1, Tertiary; 2, Pierre shale (cretaceous);** 3, Dakota sandstone (cretaceous), water-bearing; 4, Carboniferous; 5, Granite.

Digitized by Google

Some are sufficiently so to disqualify them for use for man or beast, or for irrigation even, because of the increasing accumulation of salt resulting from evaporation. There are several wells in Gage county drilled to a depth of 1,200 feet or more. In digging the well on the Government Square in Lincoln, in 1872 (as a measure of protection against fire), bed rock was struck at ninety-five feet; at 160 feet sand rock, impregnated with salt, was encountered; at 560 feet artesian water was struck; at 1,050 feet, the water being still salt, it was ordered by the council that it be abandoned. The well is still flowing. This is about the depth at which artesian water was struck by the Sanitarium, where the saline water is put to such excellent account.

The "Salt Well" or "Test Well" at Lincoln is the deepest and most important in the state. The location of this well is in the salt basin, now converted into a lake, called Burlington Beach. It was put down by the state as a test well to determine several things: the thickness of various beds, whether coal, gas, or petroleum were present, and whether rock salt might not occur. At a cost of about $20,000 this well was drilled to a depth of 2,463 feet, and the drill being a diamond one, a core was cut from top to bottom and deposited for reference and study in the state museum.

In addition to the artesian wells there are strong springs which raise water above the surface and are called artesian springs. These are reported from several counties and are destined to be put to use for supplying water for domestic use, and for the irrigation of gardens and truck patches. All of these things though small, add to the sum total of the water resources of the state. After the surface water, underflow, and ground water is used to its full capacity there yet remains a source of supply to be obtained by impounding water, by means of dams thrown across draws, canyons, and valleys.

The topography of Nebraska is such as to lend itself kindly to this work, and in the very region where the rainfall is most scant and the evaporation excessive, water may be impounded to best advantage; that is in the western tier of counties. Here there are bold canyons and deep draws at every hand. It is possible by means of small dams in many places to set water back, making deep broad lakes a mile or so in extent, according to the height of the dam. Here a sufficient supply could easily be impounded for the irrigation of rich farms in the valley below, where the soil is of the most undoubted fertility. There are fine opportunities of this character throughout all of western Nebraska, and there are those who will yet rise to them. Even in eastern Nebraska where the chances are fewer, there are opportunities for the extensive impounding of water. To go still farther it seems desirable that every draw as far as possible, even the small ones on every man's farm, should have dams thrown across them in order to check the storm water and melting snow, so that it will not flow aimlessly out of the state, but soak into the subsoil, thus saturating it during the fall and winter months, putting the soil in fine condition for cultivation. Some irrigators attach quite as much importance to this preliminary wetting of the subsoil, as to the actual work of irrigation during the growing season.

Digitized by Google

In fact this often renders irrigation unnecessary, save as a precaution against short seasons of unexpected drought and hot winds.

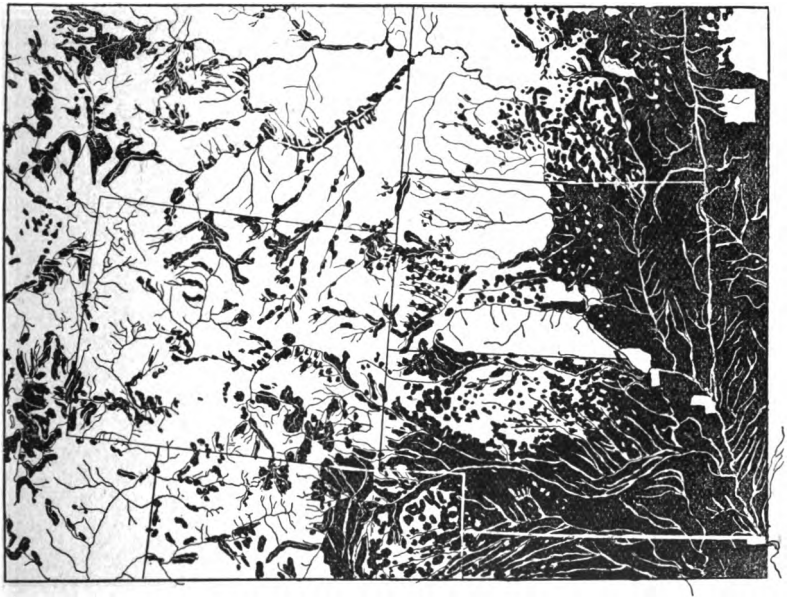


FIG. 24.—A map of Nebraska and neighboring states in the great plains showing the effect of streams upon the occupation and settlement of the plains. The black areas indicate land disposed of. West of the humid region settlement is confined closely to the water courses. Modified from a [illegible] after Newell.

Digitized by Google

Digitized by Google

REPORT OF THE ENGINEER.

By O. V. P. Stout, C.E.

The principal work of the engineer in 1897, as for several years immediately preceding, has been directed to securing data which can be used as the basis of an estimate of the value of the principal streams of Nebraska for irrigation.

To this end, gaging stations have been maintained at favorable points on the rivers, and observers have been employed to note daily the height of the water surface, as indicated by gage rods which had been placed in suitable positions for that purpose. The measurements of the rate at which water was discharged past these gaging stations have been made by trained hydrographers who have been furnished with the latest and most approved instruments designed for that purpose.

It has been assumed that at the end of a season an examination of the records of discharge measurements, together with the height of water surface at the times when discharge measurements were made, would reveal a law connecting river height and discharge, by means of which the daily rates of discharge could be estimated from the record of river heights. The rivers of this state which flow over sandy beds, and whose channels at any point are subject to frequent and extensive changes of form and even of position, are peculiarly difficult of treatment on this basis. In a few instances the daily observations of river height have proved to be of no value whatever for the intended purpose. In other instances it has been found that an apparently definite relation between river height and rate of discharge would exist for a part of the season, when a sudden flood would change completely the condition of the channel, and a new law for the subsequent part of the season would have to be deduced, or some system devised for an indirect application of the law which had previously applied. Some of the stations at which these difficulties have been most pronounced have been abandoned. Some new stations have been established, where it was believed that results of value could be obtained. We have enjoyed the continued substantial co-operation of the United States Geological Survey, Division of Hydrography, in charge of Mr. F. H. Newell, and of the Nebraska State Board of Irrigation, of which Mr. J. M. Wilson, C.E., is secretary.

The following tables of discharge of rivers are given in the same form as in previous years, and require no explanation.

Digitized by Google

GERING STATION ON THE NORTH PLATTE RIVER.

This station was established on May 29, 1897, by Mr. A. B. McCoskey, assistant state engineer.

A daily record of river heights has been kept, covering the periods May 29 to June 5 inclusive, and July 1 to October 30 inclusive.

This record of river heights, together with the results of the three measurements of discharge which were made during the season, has furnished a basis for the estimates of discharge which appear in the following table:

DISCHARGE OF THE NORTH PLATTE RIVER AT GERING, NEBRASKA, IN 1897.

PERIOD OF TIME COVERED.	DISCHARGE IN CUBIC FT. PER SEC.			TOTAL ACRE FT.
	Max.	Min.	Mean.	
May 29 to June 5 inclusive.....	27900	18700	22870	.....
July 1 to 10 "	4269	2340	3396	67330
July 11 to 20 "	2340	1428	1736	34430
July 21 to 31 "	1428	1084	1365	29780
August 1 to 10 "	2340	815	1144	22690
August 11 to 20 "	1847	1428	1596	31660
August 21 to 31 "	815	500	590	12890
September 1 to 10 "	815	500	642	12730
September 11 to 20 "	500	500	500	9919
September 21 to 30 "	500	455	469	9302
October 1 to 10 "	468	455	456	9042
October 11 to 20 "	550	468	514	10195
October 21 to 30 "	620	550	571	11325

CAMP CLARKE STATION ON THE NORTH PLATTE RIVER.

This station has not been of full value on account of its comparative inaccessibility to hydrographers. Only one measurement of discharge was made in 1897. No discharge measurement has been made when the river was in flood. The following table of discharge is therefore incomplete, in addition to being set forth somewhat tentatively. It seems probable that the work of the season of 1898 will furnish data for completing the estimates of discharge for 1897.

Digitized by Google

DISCHARGE OF THE NORTH PLATTE RIVER AT CAMP CLARKE, NEBRASKA, IN 1897.

PERIOD OF TIME COVERED.	DISCHARGE IN CUBIC FT. PER SEC.			*TOTAL ACRE FT.
	Max.	Min.	Mean.	
April 1 to 10 inclusive	2200	1550	1940	38480
April 11 to 20 "	4195	1420	2137	42390
[1] July 2 to 10 "	4195	2440	3004	59600
July 11 to 20 "	2700	1350	2026	40190
July 21 to 31 "	1560	930	1299	28350
[2] August 1 to 10 "	2000	740	1200	23800
August 11 to 20 "	2000	835	1365	27070
[3] August 21 to 31 "	740	555	631	13768
Sept. 1 to 10 "	580	450	524	10392
Sept. 11 to 20 "	550	450	498	9879
Sept. 21 to 30 "	490	410	451	8946
October 1 to 10 "	430	370	404	8014
[4] October 11 to 20 "	515	450	469	9303
October 21 to 31 "	610	555	587	12806

1. Except July 3.
2. Except August 8.
3. Except August 22.
4. Except October 12.

* Quantities in this column are computed without allowing for missing dates in ten day periods.

COLUMBUS STATION ON THE PLATTE RIVER.

The season of 1897 was the third during which an attempt has been made to obtain a complete daily record of river height at this station. The difficulty in the way of success in this has been due to the uncertainty which always exists as to the position of the channel at time of low water, making it impossible to find a position for a gage rod such that it will always indicate the height of the surface of the running water. This accounts for the fact that considerable gaps occur in the record for the late summer and the early fall.

During the season of 1897, eleven measurements of discharge were made at this station. The results of these measurements, together with those of 1895 and 1896, afford a basis for a confident estimate of the higher rates of discharge. The relation between river height and rate of discharge is not nearly so permanent when the water is at a low stage, and may vary considerably from season to season, or even during the same season.

Digitized by Google

DISCHARGE OF THE PLATTE RIVER AT COLUMBUS, NEBRASKA, IN 1897.

DAY.	MAY.	JUNE.	JULY.	AUGUST.	SEPT.	OCTOBER.
1	....	1600	8200	*a*	*a*	*a*
2	....	21600	8200	*a*	*a*	*a*
3	....	21400	7600	*a*	*a*	*a*
4	6700	27400	6400	*a*	*a*	*a*
5	7000	22600	4700	*a*	*a*	*a*
6	7350	19700	3900	*a*	*a*	*a*
7	8200	19700	3500	*a*	*a*	*a*
8	10300	20600	3500	*a*	*a*	*a*
9	12250	21600	3500	*a*	*a*	*a*
10	11250	22600	3100	*a*	*a*	*a*
11	10800	23750	2550	*a*	*a*	*a*
12	11250	31000	2000	*a*	*a*	*a*
13	11250	28575	2000	*a*	*a*	*a*
14	11250	20300	2000	*a*	*a*	*a*
15	12700	17750	2000	*a*	*a*	*a*
16	12250	16000	2000	*a*	*a*	*a*
17	12250	13300	2000	3300	*a*	*a*
18	13400	9800	*a*	4400	*a*	*a*
19	13400	8200	*a*	4400	*a*	*a*
20	12100	5500	*a*	4900	*a*	*a*
21	11250	11250	*a*	4900	*a*	*a*
22	11250	12500	*a*	4900	*a*	*a*
23	10300	11500	*a*	4400	*a*	*a*
24	9250	11100	*a*	3800	*a*	*a*
25	10800	11750	*a*	3400	*a*	*a*
26	12250	12200	*a*	3400	*a*	*a*
27	12100	12250	*a*	3400	*a*	1400
28	14675	11750	*994	3400	*a*	1400
29	15250	10750	*a*	1400	*a*	1600
30	18000	8700	*a*	1400	*a*	1600
31	21600	.....	*a*	1400	*a*	.....

a No water at gage.
* Result of discharge measurement.

ST. PAUL AND COLUMBUS STATIONS ON THE LOUP RIVER.

The stations on the Middle and North Loup rivers at St. Paul, and on the Loup river at Columbus, have been maintained for three seasons, including that of 1897.

The relation between river height and rate of discharge is very unstable at all of these stations. A daily record of river heights is therefore of little value for the purpose of estimating daily rates of discharge, unless it is supplemented by a considerable number of actual measurements of discharge, made at intervals throughout the period of time during which the river heights have been observed. Even then, the method which must be adopted to estimate the discharge is not nearly so simple nor so clearly legitimate as that which is employed in the case of streams whose main channels are more permanent in form, size, and position.

In 1897 the discharge of the Middle Loup river at St. Paul was measured

Digitized by Google

nine times; that of the North Loup river at St. Paul, nine times; and that of the Loup river at the gaging station * at Columbus, twelve times.

The United States Geological Survey has had a wire rope stretched across the river at the Columbus station. To make his measurements of depth and velocity, the hydrographer works back and forth across the river in a cage or car which runs by means of a trolley on this cable.

DISCHARGE OF THE MIDDLE LOUP RIVER AT ST. PAUL, NEBRASKA, IN 1897.

PERIOD OF TIME COVERED.	DISCHARGE IN CUBIC FT. PER SEC.			TOTAL. ACRE FT
	Max.	Min.	Mean.	
April 21 to 30 inclusive.....	1880	1420	1697	33660
May 1 to 10 "	1490	1210	1361	26999
May 11 to 20 "	1440	1180	1289	25570
May 21 to 31 "	1350	1055	1182	25790
June 1 to 10 "	1240	960	1055	20927
June 11 to 20 "	1080	860	975	19340
June 21 to 30 "	2600	860	1080	21420
July 1 to 10 "	1800	800	1080	21420
July 11 to 20 "	915	780	821	16285
July 21 to 31 "	770	660	710	16300
Aug. 1 to 10 "	885	605	693	13747
Aug. 11 to 20 "	720	645	678	13450
Aug. 21 to 31 "	690	605	648	14137
Sept. 1 to 10 "	690	585	629	12478
Sept. 11 to 20 "	705	675	692	13726
Sept. 21 to 30 "	720	670	703	13945
Oct. 1 to 10 "	870	705	770	15272
Oct. 11 to 20 "	1170	870	1026	20350
Oct. 21 to 31 "	2800	1040	1661	36245

*Two additional measurements of discharge were made at the highway bridge, about one mile down stream from the gaging station. These were made as a check on measurements at the gaging station.

Digitized by Google

DISCHARGE OF THE NORTH LOUP RIVER AT ST. PAUL, NEBRASKA, IN 1897.

PERIOD OF TIME COVERED.	DISCHARGE IN CUBIC FT. PER SEC.			TOTAL ACRE FT.
	Max.	Mn.	Mean.	
April 20 to 30 inclusive.....	1400	1130	1242	27100
May 1 to 10 "	1250	1100	1181	23420
May 11 to 20 "	1110	1020	1064	21120
May 21 to 31 "	1040	915	1004	21900
June 1 to 10 "	990	860	917	18190
June 11 to 20 "	990	840	912	18090
*June 21 to 30 "	2550	720	1291	25608
July 1 to 10 "	1890	690	1097	21760
July 11 to 20 "	780	620	720	14280
July 21 to 31 "	770	610	669	14600
August 1 to 10 "	900	620	704	13960
August 11 to 20 "	740	670	694	13776
August 21 to 31 "	690	590	633	13814
September 1 to 10 inclusive....	1100	600	697	13826
September 11 to 20 "	800	690	730	14480
September 21 to 30 "	710	670	688	13647
October 1 to 10 "	820	720	759	15053
October 11 to 20 "	1260	820	994	19719
October 21 to 30 "	1320	1080	1184	23482

* Except June 27. Exception not taken account of in column of acre feet.

Digitized by Google

DISCHARGE OF THE LOUP RIVER AT COLUMBUS, NEBRASKA, IN 1897.

PERIOD OF TIME COVERED.	DISCHARGE IN CUBIC FT. PER SEC.			TOTAL ACRE FT.
	Max.	Min.	Mean.	
March 19	.....	.....	6307	.....
March 23	.....	.....	3869	.....
March 26	.....	.....	3040	.....
March 30	.....	.....	3620	.....
April 3	.....	.....	7125	.....
April 8 to 10 inclusive	3950	3450	3683	.....
April 11 to 20 "	4100	2775	3512	69630
April 21 to 30 "	3950	2675	3302	66500
May 1 to 10 "	2875	2675	2795	55420
May 11 to 20 "	2675	2225	2485	49290
May 21 to 31 "	2575	1850	2255	49200
June 1 to 10 "	2675	1800	2320	46020
June 11 to 20 "	3150	2425	2802	55540
June 21 to 30 "	9550	2175	3550	70410
July 1 to 10	11825	1650	3730	74000
July 11 to 20	2975	1850	2280	45230
July 21 to 31	2325	1600	1909	41660
August 1 to 10	3050	1275	2055	40760
August 11 to 20	3275	1450	2130	42250
August 21 to 31	1425	1100	1 02	28410
September 1 to 10 inclusive	1350	1000	1168	23170
September 11 to 20 "	1700	1450	1577	31280
September 21 to 30 "	1600	1425	1537	30490
October 1 to 10 "	2075	1600	1802	35750
October 11 to 20 "	4800	2350	3408	67600
October 21 to 30 "	10400	4200	5055	100250

The records which are now available indicate that the relative rates of discharge of the Loup river at Columbus, and of its forks at St. Paul, have been as set forth in the following table.

Percentage of the discharge of the Loup river at Columbus, Neb., contributed by the Middle and North Loup rivers at St. Paul, Neb.

YEAR.	MAY.	JUNE.	JULY.	AUGUST.	SEPT.	OCTOBER.
1895	83.1	81.5	81.3	85.5	81.1	81.1
1896	73.4	*a*	87.5	69.4	77.5	73.2
1897	94.2	71.6	64.6	74.3	96.6	62.8

a Omitted on account of great freshet.

NORFOLK STATION ON THE SOUTH FORK ELKHORN RIVER.

The fact that the South Fork of the Elkhorn river at Norfolk flows over a bed of sand, would lead us to expect little permanence in the relation of river height to discharge. However, the results of the nine measurements

Digitized by Google

of discharge, which were made in 1897 indicate that the same law can be applied throughout the entire season to estimate the daily rates of discharge from the record of river heights.

DISCHARGE OF SOUTH FORK ELKHORN RIVER AT NORFOLK, NEB, IN 1897.

PERIOD OF TIME COVERED.	DISCHARGE IN CUBIC FT. PER SEC.			TOTAL ACRE FT.
	Max.	Min.	Mean.	
May 1 to 10 inclusive.....	940	620	723	14340
May 11 to 20 "	590	440	518	10275
May 21 to 31 "	430	320	375	8184
June 1 to 10 "	370	310	338	6702
June 11 to 20 "	310	275	295	5851
June 21 to 30 "	320	255	272	5392
July 1 to 10 "	325	220	273	5412
July 11 to 20 "	380	200	255	5059
July 21 to 31 "	260	180	209	4560
August 1 to 10 "	275	165	227	4503
August 11 to 20 "	245	195	223	4423
August 21 to 31 "	180	150	172	3753
September 1 to 10 inclusive...	160	115	143	2837
September 11 to 20 " ...	190	150	167	3313
September 21 to 30 " ...	185	145	165	3273
October 1 to 10 " ...	170	140	151	2995
October 11 to 20 " ...	260	170	215	4265
October 21 to 31 " ...	295	230	256	5586

SUPERIOR STATION ON THE REPUBLICAN RIVER.

When this station was established in 1895, the fact that a dam with a nearly level crest is located a short distance below the gage rod, and that under ordinary circumstances a large proportion of the flow of the river passes over this dam, led to the expectation that some simple law, of a nature similar to that governing the flow of water over weirs, would be found to exist between river height and discharge. It has been found that the complicating influence of the mill race, which heads just above the dam, has been underestimated, and that it seems impossible, with the gage rod in its present position, to establish a perfectly satisfactory law for the estimation of discharge from river height.

Ten measurements of discharge were made in 1897, but as none of these were made at time of very high water, it is impossible at this time to estimate the rate of discharge corresponding to the greatest river heights. This fact accounts for the greater number of omissions in the following table of discharge. When some flood gagings of the river have been made and the corresponding river height observed, these omissions may be supplied.

Digitized by Google

DISCHARGE OF THE REPUBLICAN RIVER AT SUPERIOR, NEBRASKA, IN 1897.

DAY.	JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.
1	.....	900	.....	.....	665	190	555	94	110	.....
2	555	.....	636	820	575	180	.....	110	85	.....
3	.....	.....	.....	.....	500	220	.....	94	64	60
4	.....	.....	.....	880	480	220	.....	90	.....	.....
5	.....	.....	.....	.....	457	180	.....	110	75	.....
6	600	900	506	.....	475	241	.....	330	74	.....
7	.....	.....	506	990	445	370	.....	1460	64	.....
8	.....	.....	.....	1388	420	270	.....	395	.....	.....
9	.....	.....	.....	1190	575	230	.....	390	.....	.....
10	.....	.....	457	1074	600	212	1010	310	.....	.....
11	.....	900	.....	1095	470	750	770	305	.....	.....
12	.....	.....	.....	1190	440	550	506	390	70	.....
13	600	.....	.....	1252	420	.....	350	375	85	.....
14	.....	.....	.....	1050	370	.....	265	380	60	.....
15	.....	900	516	1035	360	.....	230	101	64	.....
16	.....	.....	.....	.....	341	.....	190	119	241	75
17	.....	.....	385	.....	330	.....	190	119	180	.....
18	.....	.....	.....	1252	305	.....	220	140	180	.....
19	.....	880	.....	1074	280	.....	170	155	125	.....
20	700	.....	425	990	255	490	230	212	1130	1420
21	.....	.....	.....	945	230	405	206	171	82	1160
22	.....	.....	650	920	250	320	160	206	75	1130
23	900	.....	465	740	1130	290	140	190	.....	1160
24	900	880	.....	880	445	330	165	395	64	.....
25	900	.....	.....	840	425	226	120	341	70	1010
26	900	.....	.....	675	395	.....	165	265	.....	1070
27	900	.....	457	620	445	.....	130	212	.....	.....
28	900	.....	.....	.....	280	.....	640	180	.....	.....
29	900	.....	.....	.....	270	.....	206	165	.....	.....
30	900	.....	.....	840	220	.....	131	119	82	.....
31	.....	.....	610	.....	180	.....	119	105	.....	.....

CRAWFORD STATION ON WHITE RIVER.

The Crawford Station on White River was established on June 26, 1897. It was located about six miles southwesterly from Crawford. At a distance of a few hundred yards up stream from the gaging station all of the water of the stream is diverted into the canal of the Crawford Water Power and Irrigation Company. As the measurements of discharge and observations of river height could be made more conveniently in the canal than at some place above the point of diversion, the gaging station was located as above stated.

Although White River is not a large stream as compared with others upon which stations have been maintained, the institution of important suits at law to determine the rights of users of water from the stream has made a precise knowledge of the stream itself a matter of immediate necessity.

Digitized by Google

DISCHARGE OF WHITE RIVER AT CRAWFORD, NEBRASKA, IN 1897.

PERIOD OF TIME COVERED.	DISCHARGE IN CUBIC FT. PER SEC.			TOTAL ACRE FT.
	Max.	Min.	Mean.	
July 13 to 20 inclusive.....	18.0	10 0	12.6	.....
July 21 to 31 "	14.2	10.8	12.6	275
August 1 to 10 "	14.2	10.2	12.8	254
August 11 to 20 "	13.8	10.4	11.8	234
August 21 to 31 "	10.8	9.1	9.8	214
Sept. 1 to 10 "	11.1	8 9	9.3	184
Sept. 11 to 20 "	12 0	10 8	11.3	224
Sept. 21 to 30 "	12.0	11.1	11.8	234
October 1 to 10 "	13.2	11.8	12.5	248
October 11 to 20 "	15.4	12.9	14.5	288
October 21 to 30 "	15.6	14 0	15.0	297

FORT NIOBRARA STATION ON THE NIOBRARA RIVER.

This station was established on July 22, 1897. The consideration which governed chiefly in the selection of this location is the fact that it is about the only point on the river after it has become a stream of considerable size which can be reached readily and without loss of time by the hydrographers.

Five measurements of discharge were made. A most careful examination of the results of these measurements fails to reveal any law connecting river height and discharge; hence no extended table of discharge can be given.

Following is a list of the discharge measurements:

LIST OF DISCHARGE MEASUREMENTS MADE ON NIOBRARA RIVER AT FORT NIOBRARA, NEBRASKA, IN 1897.

DATE.	RIVER HEIGHT (FT.)	DISCHARGE (SEC. FT	HYDROGRAPHER.
June 24	0.59	925	O. V. P. Stout.
July 22.....	0.48	883	O. V. P. Stout.
August 15.....	0.38	703	O. V. P. Stout.
September 1	0.46	730	O. V. P. Stout.
October 16.....	0.21	845	Adna Dobson.

MISCELLANEOUS MEASUREMENTS OF DISCHARGE IN 1897.

Whenever time permitted or opportunity offered, it has been the practice of the hydrographers who were charged with the duty of measuring the discharge at gaging stations to make such other measurements of discharge of streams, both large and small, as might at sometime be of interest or value in any connection. As a natural result of the ends which the

Digitized by Google

State Board of Irrigation has immediately in view when it proceeds to such work, it follows that the measurements which have been made under the directions of that board are nearly all of a miscellaneous nature.

Following is a list of measurements, at points other than gaging stations, which have been made by the writer or have been reported to him:

MISCELLANEOUS MEASUREMENTS OF DISCHARGE IN 1897.

DATE.	STREAM.	LOCALITY.	MEAN V.	DISCH.	HYDROGRAPHER.
March 24....	N. Fork Elkhorn...	Norfolk	0.91	701	Adna Dobson
" 28....	Blue Creek	N. E. ¼ of *30-16-42	3.15	115	"
April 13....	Republican	McCook	2.62	745	"
" 14....	Frenchman	Wauneta	3.43	127.93	"
May 6....	N. Fork Elkhorn...	Norfolk		166	"
" 19....	Frenchman	Wauneta			"
" 24....	N. Fork Elkhorn...	Norfolk		77	"
" 28....	Oak Creek	Dannebrog			"
" 28....	M. Loup	Boelus		837	"
" 29....	South Loup	St. Michaels		220	"
1 June 22....	Niobrara	Niobrara City	1.99	759	O. V. P. Stout
2 " 23....	Elkhorn	O'Neill	1.08	20.63	"
3 " 24....	Minnechaduza	Valentine	1.25	21.2	"
4 " 25....	Niobrara	Lavaca P. O.	2.27	105	"
5 " 26....	White River	Below Crawford	0.81	13.4	"
6 July 2....	Frenchman	Palisade	0.95	63.23	"
7 " 19....	Frenchman	Palisade	1.02	73.3	"
8 " 21....	White River	Below Crawford	1.32	9.74	"
" 23....	Gordon Creek	15-32-29	1.68	3.53	
" 23....	Snake	At mouth	3.33	280	"
" 24....	Snake	Above mouth of Boardman Creek		215	"
" 24....	Boardman Creek...	2 miles above mouth		Est 1.	"
" 24....	N. Loup	Below mouth of Wauneduza Creek	1.88	129.8	"
9 " 30....	N. Fork Elkhorn...	Norfolk	1.40	69.8	"
" 19....	Republican	McCook		0.0	"
11 Aug. 14..	White River	Below Crawford	0.82	8.0	O. V. P. Stout & A. B. McCoskey
10 " 14..	Soldier Creek	* 5-31-53 near Crawford	1.12	2.28	O. V. P. Stout
12 " 21..	Blue River	Beatrice	1.03	203	"
13 Sept. 3..	Elkhorn	Ewing	0.81	9.77	"
14 " 3..	S. F. Elkhorn	Ewing	1.38	18.17	"
15 " 7..	Platte River	Grand Island		Dry	"
16 " 15..	Platte River	Grand Island		12	"
17 July 8....	Boggy Creek	Between secs. 17-18 t32 r54		0.15	A. B. McCoskey
" 8....	Boggy Creek	* 31-33-54		0.35	"
" 10....	East Hat Creek	N. W. ¼ * 23-32-55		0.80	"
" 10....	East Hat Creek	Just above mth * 14-33-55		1.05	"
" 10....	West Hat Creek	Just above mth * 14-33-55		0.53	"
" 10....	Hat Creek	Just below confluence * 14-33-55		1.60	"
18 " 14....	Sow Belly Creek	Bodarc P. O.		1.54	"
" 16....	Hat Creek	At head of Brewster ditch * 16-32-55		0.69	"
" 16....	Sow Belly Creek	Above head of Shaefer ditch N. E. ¼ * 7-32-55		1.45	"
" 16....	Schaefer Ditch	N. E. ¼ * 7-32-55		0.30	"
" 20....	Monroe Creek	At head of Schilt ditch S. W. ¼ * 27-33-56		0.22	"
19 " 21....	Monroe Creek	At head of Wilcox ditch N. E. ¼ * 33-33-56		1.02	"
" 21....	Spring branch of Warbonnet Creek	At head of Bickle ditch S. W. ¼ * 32-33-53		0.27	"
" 21....	Middle branch of Warbonnet Creek	At head of Garton's ditch S. W. ¼ * 31-33-56		0.26	"
" 22....	Jim Creek	Above Woodruff's dam S. E. ¼ * 14-33-57		0.22	"
" 22....	Squaw Creek	At Patrick Dann's		0.13	"

Digitized by Google

MISCELLANEOUS MEASUREMENTS OF DISCHARGE IN 1897—*Continued.*

DATE.	STREAM.	LOCALITY.	MEAN V.	DISCH.	HYDROGRAPHER.
" 23...	War Bonnet Creek	At Brewster's ranch * 21-33-56		0.51	A. B. McCoskey
" 24...	Sow Belly Creek.....	At bridge south of Gilchrist P. O		0.08	"
Aug. 11.....	White River.....	About 1 mile below mouth of Kyle creek		6.6	"
" 18.....	White River.....	At R. R. bridge above Glen		5.7	"
" 18.....	West Ash Creek.....	At head of Mace ditch S. W. ¼ * 2-31-51		0.96	"
Sept. 9.....	White River.....	At Elkhorn bridge below Crawford		6.96	"
" 14.....	Chadron Creek	Above head of Chadron water works		1.59	"
" 14.....	Chadron Creek	Below Chadron water works dam		0.96	"
" 20.....	White River.....	Below Crawford		7.53	"
October 15..	Horse Creek.....	At state line above Gering		10 5	"
" 18..	White River.....	Below Crawford		10.13	"
" 20..	Niobrara	At state line		3.56	"
" 20..	Niobrara	Above Warneke's dam * 27-30-57		5.12	"
" 21..	Niobrara	Above Wm. Burrett's dam * 33-30-56		6.36	"
" 21..	Niobrara	Above Earnest's dam * 9-29-56		7.36	"
" 21..	Niobrara	At Joe Earnest's house W. line * 23-29-56		16.34	"
" 22..	Niobrara	At McGinley's ranch S. line * 31-29-55		9.27	"
" 23..	Niobrara	At house of Octave Harris t28 r54		13 44	"
" 23..	Niobrara	N. W. ¼ * 8-28-53 near Bell P. O		11.92	"
" 25..	Niobrara	At B. F. Moore's ranch near W. line * 11-28-53		17.1	"
" 25..	Niobrara	At McLaughlin's ranch N. E. ¼ * 10-28-52		16.79	"
Nov. 5.....	White River.....	Below Crawford		10.58	"
April 26.....	Niobrara	Head of proposed Golden ditch * 13-31-41		190	
20 " 27.....	Niobrara	1½ miles below head of proposed Golden canal		195	Engineers in employ of Golden Irrigation District.
March 22....	Snake	* 2-30-31		250	
April 13.....	Snake	* 2-30-31		225	
March 16....	Snake	4 miles east of * 2-30-31		222	
April 13	Snake	7 miles east of * 2-30-31		240	
March 23....	Boardman Creek	Locality not given		60	
April 10.....	Boardman Creek			42	

NOTES.

1. Not a good gaging on account of inability to measure depths accurately in deepest part.
2. Gaging made at section about one hundred yards below dam at head of mill race; no water in mill race. Discharge apparently normal.
3. Gaged at section one mile above mill dam where back water does not interfere with normal flow.
4. Distance from surface of water at left edge to top of out-side bar of bottom chord of upstream truss equals 6.60 feet.
5. Gaging made just above back water of mill pond. Discharge as given is probably in excess of true discharge on account of retarding effect of aquatic vegetation bottom velocities.
6. Discharge as given consists of 61.29 sec. feet measured in Culbertson canal and 1.94 sec. feet which was running just below diversion dam of said canal. Surface of water in canal is 5.17 feet below top of foot bridge at left edge.
7. Discharge as given consists of 67.6 sec. feet measured in Culbertson canal and 5.7 sec. feet measured in river bed below head of canal. Distance of surface of water in canal below top of foot bridge at a point just north of North Channel support is 5.09 feet. Rain storm about five hours previous to gaging, water slightly roiled but stream not in flood.
8. Gaging made fifty yards below bridge of F. E. & M. V. R. R.

Digitized by Google

9. Water almost perfectly clear. Mill running.
10. Water perfectly clear. Good gaging about 1.75 sec. feet in left fork; balance from right fork.
11. Gaging made between wagon bridge and bridge of F., E. & M. V. R. R. Result by acoustic meter equals 7.97 sec. feet. Result by meter No. 105 equals 7.84 feet.
12. Water not very clear, but stage apparently normal. Accuracy of gaging impaired by difficulty in measuring widths due to rock bottom.
13. Water perfectly clear and fairly cool.
14. Water clear.
15. Water in pools, no running water.
16. Estimate of combined discharge of a half dozen rills, which constituted all the running water in the stream.
17. Tributary of Hat Creek.
18. Tributary of Hat Creek.
19. Wilcox takes all the water, Schilt is below him on the stream.
20. On April 18, 1897, the river was running one-half foot higher than at the time of this gaging, which height corresponds to an estimate of 345 sec. feet. The estimated discharge at high water is from 600 to 700 sec. feet.

* The figures represent respectively the section, township north, and range west of the 6th principal meridian, in which the gaging was made.

Digitized by Google

Digitized by Google

REPORT OF THE ENTOMOLOGIST.

By W. D Hunter.*

LEPTOCORIS TRIVITATTUS, Say.

Say, Journal Academy Natural Sciences, Philadelphia. Volume IV., page 322, 1825. (Lygaeus.) Leconte edition volume II., page 246.

BOX ELDER BUG.

Probably there is no insect concerning which more inquiries are made throughout the year at this office than the Box Elder Bug. Its not inconspicuous appearance, its habit of assembling in easily observable places, and its inexcusable persistency in seeking hibernating quarters in our dwellings and offices have brought it to universal notice and condemnation.

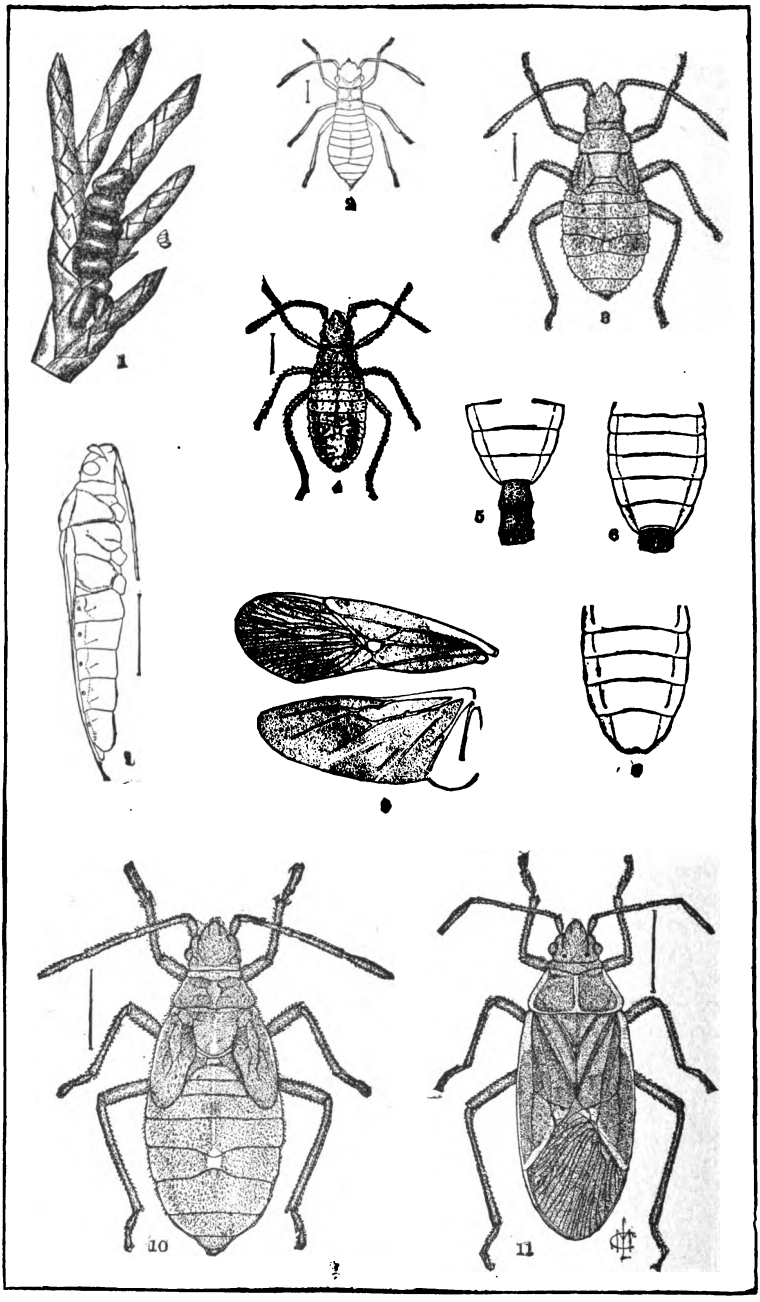
This insect when full grown is about one-half inch in length; of a deep slate black color variegated with red; this red consists of three longitudinal stripes (which give the insect its Latin name) the middle one of which is confined to the thorax, and the outer ones of which continue beyond the thorax along the edges of the wings. Besides these there are two similar but oblique lines along the division between the thickened basal and apical portion of the wings.

The young are without wings and with a greater extent of red, especially in the newly hatched individuals which are almost entirely red. Young and old are always found indiscriminately together throughout the summer season. There are other species found commonly in this region which resemble very much this one, but they may be distinguished by the fact that there is usually a white mark on the wings and that the basal portion of legs are black, not red, as in the present case.

The eggs of this insect are deposited throughout the spring and summer months in the crevices of the bark of the Box Elder tree preferably, although other trees, cracks in walls, stones and lumber, or loose earth, etc., are sometimes selected. As soon as the small, red-colored young emerge, they scatter to obtain suitable food—box elder (*Acer negundo*) or ash, although the range of food plants is quite extensive. The slender, sharpened beak, even in the young nearly as long as the body, is inserted in tender parts of the plant and the juice extracted. By autumn they are full grown, having attained wings, and select protected places such as

* The entomological work in the University of Nebraska has been in the hands of Walter D. Hunter during the past year, Professor Bruner's absence in South America has necessitated the abridgement of this annual report of the acting state entomologist.

Digitized by Google



Box Elder Bug: 1, a twig of red cedar, with eggs, greatly enlarged; 2, larva, first stage; 4 and 3, later stages in order; 10, pupa; 11, mature insect; 5,6, 7, 8, and 9, detail drawings. After C. L. Marlatt.

Digitized by Google

houses, old stone walls, rubbish, and brush heaps for hibernation, pass the winter there, and fly out in the spring to deposit eggs.

The distribution of this insect reveals some remarkable facts, and its eastward spread finds a parallel only in the case of the Colorado potato beetle. It was described by Thomas Say in 1825 from specimens taken in Missouri, and next appears in the literature of the subject in 1870 in Stahl's "Enumeratio Hemiptorum," and has, at this time, also been taken in Mexico. By 1878 it had been recorded from Arizona, Colorado, and Utah, and was known as an annoying and even destructive pest in Kansas and Nebraska. Since that time it has spread from this region in which it was practically indigenous, but where it has noticeably increased during the past ten years, into regions where it was before entirely unknown. Northward, Idaho, Oregon, Washington, and Minnesota, and eastward, New York and Pennsylvania have been invaded. Its range, it would appear, is only limited by the natural range of the box elder or of the region where it is cultivated.

In Nebraska this insect was observed at Lincoln by Professor Bruner as early as 1871, though not in injurious numbers, and as far north in the state as West Point, over twenty years ago. It was not, however, so far as we have been able to ascertain, until about 1889 that it was present at Lincoln or elsewhere in numbers sufficient to excite comment. Since that time it has been steadily becoming more common. It was treated by Professor Bruner in the report of the State Horticultural Society for 1895 page 179.

Foremost among the traits that make this insect obnoxious is the habit of congregating in autumn and invading dwelling houses, where they seek warm quarters for winter. During this season they emerge, during warm days, from crevices in which they seem to be so numerous that a continual process of sweeping up and burning seems to have but little effect in diminishing their numbers and causing annoyance, besides from their presence, by staining white curtains, oiled floors, and instruments, and by dropping into receptacles for food and drink. Cases have come to our notice where persons of especially neat tastes, after brushing and dusting and fumigating, had become disgusted at the seeming impossibility of reducing the numbers of this pest, and have given up the fight in disgust and moved away.

As an enemy of the box elder tree this species will rank hardly as a second class pest. Young trees are sometimes stunted, but, as far as we have observed, never fatally or even seriously affected. In the extreme Northwest where the original food plant is not present, but into which region this insect has spread, it is less restricted in its food habits and has been known to damage the fruit of peach, plum, and pear trees to a very considerable extent. We have heard unsubstantiated rumors that it attacks tomatoes, but have not ourselves observed it feeding upon them in Nebraska. As a matter of fact, in our laboratory repeated experiments have shown that at least when hibernating it will not partake of fresh apples or potatoes. Sometimes it will insert its beak, take a taste, as it

Digitized by Google

were, and remove it at once apparently in disgust. However, Professor Bruner observed at one time several years ago that apples growing near Lincoln were sometimes covered with the bugs and some damage had resulted. This seems to be rather exceptional.

Remedies.

The only effective method of fighting these pests is in spraying them with kerosene emulsion when congregated upon the trees in the spring or fall. Application at the former time will kill the eggs as well as all subsequent stages, and at the latter time will destroy the survivors.

Hot water has also been found useful at such times, but its use, although involving less expense, does involve more trouble. After they have invaded the house it is doubtful if the most assiduous sweeping and destroying will do away with them, although much relief may be obtained by persistent efforts against them. Dusting with insect powder, however industriously carried on, seems to be of comparatively little value. The use of traps or baits is equally futile. It may sometimes be possible to abate the annoyance by removing box elder trees that surround the dwellings, especially in cases where they overhang the house.

Professor Bruner has noted a white fungus disease (*Sporotriclum globuliferum*, Speg.) upon specimens of this species. This is the same fungus that has been spread artificially with more or less success among chinch bugs, and is very easily propogated artificially upon locusts and beetles. Upon locusts it has been used in Argentina in South America, when the weather conditions are not adverse, with some measure of success as a means of fighting them. In that country, from which it was described in 1880, it is very often found upon a large number of species of insects, chiefly, however, Coleopterous.

CERESAS BUBALUS Fabricius.

HARRIS.

"The Horticulturist." New Series, volume III., page 283 (1853).

"Boston Cultivator." Volume XV., page 250 (1853).

FITCH.

"Third Report Insects of New York." "Transaction State Agricultural Society, 1856," page 335.

"American Agriculturist," volume XXI., page 172 (1862).

"Twelfth Report Agricultural Society, New York," (1868), page 889.

"Country Gentleman." Volume XIX., page 335 (1862).

"Country Gentleman." Volume XXIII., page 386 (1862).

WALSH AND RILEY.

"American Entomologist." Volume I., page 38 (1868).

RILEY.

"American Agriculturist." Volume XXXI., page 302 (1872).

"Fifth Report on Insects of Missouri," page 121 (1872).

"American Naturalist." Volume XV., page 823 (1882).

"Rural New Yorker." Volume XLII., page 56 (1882).

Digitized by Google

"Prairie Farmer." Volume LV., page 86 (1883).

LINTNER.

"Report of the State Entomologist, New York." Volume 1., pages 315, 318, 331,(1885); volume IV., pages 146, 147, 208 (1889); volume VII., page 360 (1892); volume VIII., page 294 (1893); volume IX. ,page 390 (1894).

PACKARD.

"Insects Injurious to Forest and Shade Trees, pages 535 (1880).

WALTON, ALICE B.

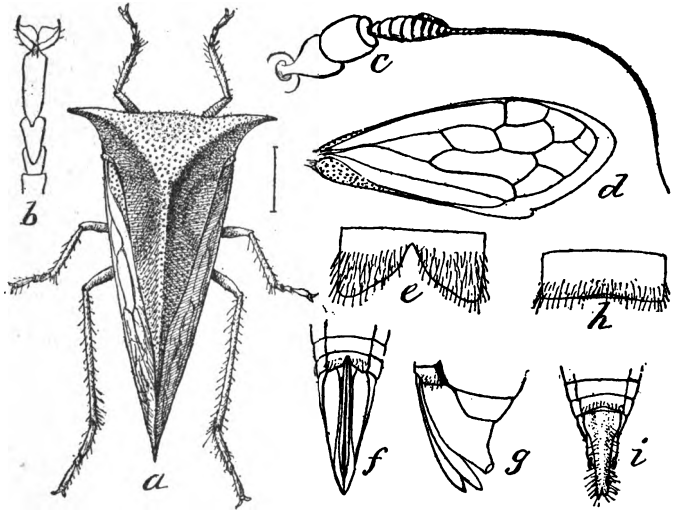
"Transactions, Iowa Horticultural Society." Volume XV., page 516 (1880).

OSBORN.

"Bulletin Agricultural College of Iowa." Volume II., page 7 (1884).

MARLATT.

"Proceedings, Kansas Academy of Science." Volume X., page 84 (1886).



Ceresa bubalus; *a*, female; *b*, same anterior foot; *c*, same, antenna; *d*, same, wing; *e*, same, last ventral segment; *f*, same, ventral view; *g*, same, lateral view; *h*, penultimate ventral segment of male; *i*, ventral view tip of abdomen of male. [Insect Life.]

JACK, J. G.

"Canadian Entomologist," Volume XVIII., page 21 (1886).

"Canadian Entomologist," Volume XVIII., page 511 (1886).

SAUNDERS.

"Insects Injurious to Fruits." Second edition, page 44 (1889).

RILEY AND HOWARD.

"Insect Life," Volume II., 130 (1890).

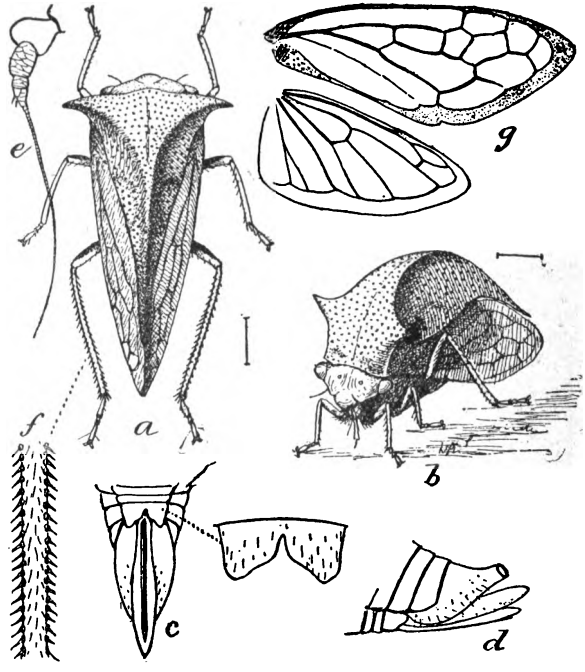
"Insect Life," Volume III., 5 (1891).

"Insect Life," Volume V., 92 (1893).

Digitized by Google

"Insect Life," Volume VI., 206 (1894).
"Insect Life," Volume VII, 14 (1895).
WEED.
"Insects and Insecticides," 30 (1891).
GILLETTE AND BAKER.
"Hemiptera of Colorado," 65 (1895).
SMITH, J. B.
"Economic Entomology," 138 (1896).

This grotesque looking insect, well described by its common name Buffalo Tree-hopper, annually causes great damage in situations where young and tender vegetation occurs. Nurseries and vineyards are favorable



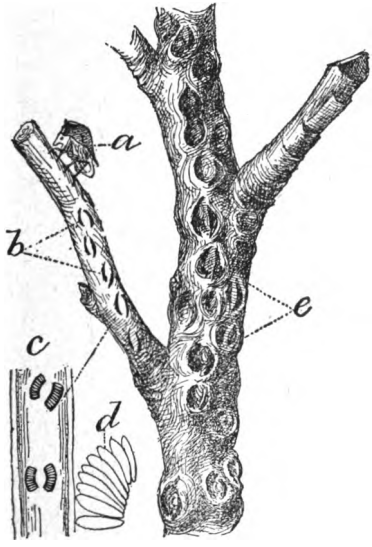
Ceresa taurina Fitch. Related to *C. bubalus*: *a*, adult female; *b*, same; *c*, tip of abdomen of female; *d*, same; *e*, antenna; *f*, posterior tibia. [Insect Life.]

situations for it, although the new twigs of old trees are sometimes injured. The damage results from breaks in the bark, making the plant attacked especially susceptible to disease and injury from other insects, and results in the drying up and stunting, or, in many cases, causes breaking off by the wind of the parts affected.

The eggs are deposited in crescent-shaped slits about one-fourth of an inch long. These slits are placed opposite one another with the cavities facing. About ten eggs are deposited in each of the openings. The grow-

Digitized by Google

ing twigs of plants furnishing softer material to work upon are almost invariably selected, and very many of these pairs of slits may be placed in a few inches along the bark. Injury resulting is not so much from the presence of the eggs as from the fact that these slits are of such form as to kill the wood between them, and, moreover, a liquid seems to be secreted by the insect that has a poisonous effect upon the plant tissue. Nature doubtless had in mind that this would reduce the danger of the eggs becoming crushed, by the growing and expanding of the plant, to a minimum. It certainly does so and even results in the dying of the twigs entirely. Almost all varieties of succulent vegetation are selected for this purpose, and attention is attracted to the injury only in cases where nursery stock is attacked or where the insects have become especially numerous among older trees.



Ceresa bubalus Fab. Twig of apple showing: *a*, female at work; *b*, recent egg punctures; *c*, bark reversed with eggs in position; *d*, single row of eggs enlarged; *e*, wounds several years standing. [Insect Life, Marlatt.]

The means to be used against this insect are: first, the finding and destroying of the eggs by pruning off the affected twigs; second, the use of trap crops; and, third, the destruction of the adults.

Under the first of these headings during the fall twigs thus scarred should be cut off and burned. It is quite likely that this procedure alone would result in obtaining comparative immunity in a few seasons. In badly infested nurseries or orchards a method which at least has some appearance of carrying success with it has been suggested. It consists of planting a crop of some such plant as beans, especially attractive as food for these insects, between the rows of trees. Eggs are deposited here, and when the larvae have partially matured this trap crop is sprayed with kerosene emulsion of unusual strength. In case such a crop as beans is used it will be of very little hindrance if it is destroyed at the same time as the insects.

The adults are of such an active disposition and so retiring in their habits that it is almost impossible to get near enough to them to apply a spray effectively. Moreover, the range of food plants is so extensive that it would be necessary to spray such an area of vegetation that the attendant expense would place this method beyond reach of most cultivators. In certain situations, notably in vineyards or wherever vegetation

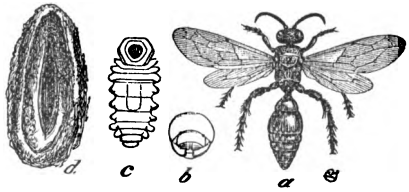
Digitized by Google

affected by these insects is planted in rows, much good may be accomplished by a method which is much followed in France. It consists of passing a canvas sheet five or six feet square, smeared on one side with tar or some similar viscid substance, along one side, while a second person passes along the opposite side of the row and by beating upon the foliage drives the insects against this sheet where they are held fast and killed. By frequent going over in this manner it is claimed that practically all of the pests may be destroyed.

Finally, it should be borne in mind that clean cultivation is the best method, by all means, of reducing the damage by these pests. It has been observed that all orchards that are badly affected are such as have been allowed to grow up with weeds and in which rubbish and prunings have been allowed to accumulate, and that, on the other hand, orchards in which clean process of cultivation has been in vogue are very rarely affected.

WHITE GRUBS.

Perhaps the commonest and most widespread insect, and yet the one concerning which our knowledge is in the most unsatisfactory state, is the May beetle, the early stages of larvae of which are commonly known as white grubs. Since the very beginning of the study of economic entomology this insect has attracted the greatest attention, and yet it seems at present that we are not possessed of knowledge at all complete and satisfactory of its life history, much less of the methods of effectually preventing its damage. The earliest account of remedies and preventives given by Ratzeburg in 1839 has had little of practical value added to it.



White Grub Parasite; *a*, imago; *b*, head of larva; *c*, larva; *d*, cocoon. [After Riley.]

White Grub Fungus. [After Riley.]

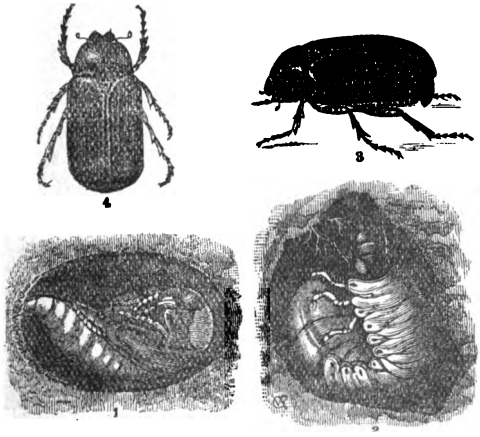
These insects affect almost all field and garden crops alike, and when a crop in which the plants are not thickly placed, such as corn, succeeds one in which the plants are very densely placed, such as wheat, the lessened amount of food for the same number of grubs results in a very decided degree of injury. Cases of this description have come to our notice where young orchards had been planted in what had previously been grass or pasture land. In such cases during the first season eight or ten grubs would be found collected at the roots of each

Digitized by Google

one of the trees, a number abundantly sufficient to make the fate of such orchard certain.

Difficulties encountered in fighting these insects lie in the fact that they are found under the ground, sometimes at a considerable distance, and at all times are spread over sufficient territory so that great expense would attend the application of any insecticide preparation. Moreover, they live as larvae in the ground for two seasons, and it results that if they infest a field one year it will likewise be so infested the next.

The eggs, small, transparent, whitish objects, are deposited in this latitude in the latter part of June. Soft, friable ground is selected, and the eggs in masses are placed a few inches below the surface attached to the rootlets or may be simply free in the ground. In a fortnight, under favorable conditions, these hatch and the young grub descends to feed upon succulent roots and passes the summer, the following winter, and part of the next summer in this stage. About the middle of the second summer the pupa or quiet stage is entered, in which the insect is enclosed in a brown, hairy cocoon-like shell, and in the fall succeeding the beetle or imago emerges, but does not, however, leave the ground. The second winter is passed in this stage and the beetle emerges to spend a month or more as a perfect insect in the spring.



The Common May-beetle (*Lachnosterna fusca*): 1, the pupa; 2, the larva or White grub in its ground cell: 3 and 4, the beetle, side and dorsal views. [After Riley.]

The remedies to be used in the case of this insect are directed either against the beetles when most may be accomplished, or against the grubs. Methods coming under the former heading take the form of poisoning or of catching and destroying. The beetles feed upon a large number of varieties of trees and shrubs and when assembled, as is often the case, in immense numbers, it is advisable to spray such trees as are selected with the usual Paris green or London purple preparations. Every female beetle destroyed at this time will be equivalent to the destruction of scores of grubs, and it will thus be seen that some little expense and trouble in this direction would be warranted.

The propensity of these insects to be attracted to lights is well known. It is, in fact, the very characteristic that has made them known and condemned everywhere. Much might be accomplished by placing lights overhanging tubs of water upon which some few drops of kerosene have been

Digitized by Google

placed. The beetles fly against the light, drop below in their usual clumsy manner, and are immediately killed by contact with the oil. Various modifications of this device will readily suggest themselves. It should be borne in mind in this connection, however, that the females are attracted to the light, according to the investigations of Professor Forbes, only in the porportion of one to sixteen males, and that the ratio of males to females when feeding is 1.3:1. It thus appears that the poisoning method is quite likely to be more efficient, although it seems advisable that trapping, on account of its very inconsiderable expense, should always be made use of in connection with it.

For fighting these grubs on a large scale no method has been devised that, if effective, is not entirely too expensive to be practiced generally. Poisoned baits, tobacco decoction, whale oil soap, gasoline, and strong salt solutions have been used invariably without success, although the indications are that the first method might be used under certain circumstances. It is quite possible that a potato thoroughly soaked with a solution of Paris green placed below the surface near the roots of freshly planted trees would bring about the destruction of many of the grubs. At least experiments carried on by Prof. Forbes in Illinois seem to indicate that such may be expected.

On a smaller scale, however, there are several methods that are more hopeful. The well known kerosene emulsion may be used upon lawns and in similar situations, and if the ground is thoroughly drenched the grubs will be killed.

In our experimental work at the University we have been able under certain conditions to use carbon bi-sulphate with considerable success against this insect. Our first experiments were carried on through Mr. B. A. Roberts, of Albion. During June he wrote us that a cherry orchard of 1,000 trees planted upon land from which timber had been cleared the preceding year, was much affected. The trees began to die here and there and investigation revealed the fact that there were from three to six grubs at the roots in each case, which had entirely eaten away the bark and destroyed some of the underlying fibre. The next spring over 100 of the dead trees were taken out, and this condition was found to be general. At our suggestion two drams of carbon bi-sulphate were inserted a few inches below the surface and examination afterwards proved that the grubs were destroyed in most cases. Similar experiments carried on subsequently at other places and which are to be continued seem to indicate that when perfected this method will be of great value.

Digitized by Google

REPORT OF THE ZOOLOGIST.

By Henry Baldwin Ward, Ph.D.

Among the various questions which appeal powerfully to the growing state of Nebraska, none is of greater importance than the matter of pure food. This is true from the double standpoint both of the individual and of the community, for the individual desires for himself the best meat that can be obtained and, on the other hand, the community finds it imperative that that which is raised for export to other communities should be of the highest quality in order to demand the best price and give the greatest return for the labor expended in its production. Nebraska, which has already forged to the front rank of meat producing states in the Union, finds this subject of supreme importance for, in the keen competition which exists, unless the supply of meat which is raised here and sent to market excels in quality that from other regions, the returns are certain to be decreased and the state will ultimately lose its growing prestige in this field.

The problem of meat production may be considered from a number of standpoints. The most prominent, and one which is always first of consideration, is the financial; and the problem of feeding cattle so as to produce the largest quantity of meat by the expenditure of a given sum has received considerable attention, until it may fairly be said that the intelligent feeder attains results at present which are greatly in excess of what was possible previously. The necessity of pure food for the cattle is generally acknowledged, and is emphasized especially in connection with the recurrence of frequent attacks of disease, with consequent financial loss. During the past year, for instance, the use of food infected by ergot has entailed in a number of places considerable financial loss.

There is also another aspect in which the question of satisfactory food for cattle demands more careful consideration than has been given it hitherto. By means of food unsatisfactory in quality, there is frequently introduced into stock parasitic infections which, in the extreme case, result in epidemics of disease where no one could doubt the attendant financial disaster. More commonly, however, it is not true that a parasitic infection shows itself in any such striking way. It is rather the reduced tone of the animals in the herd, the lessened production of flesh, and consequently the greater cost of that which is produced, as well as reduced vitality and the greater susceptiblity to disease—it is rather all these in varying degree which are directly traceable to lack of care in reference to the supply of food and more particularly to the lack of care regarding the

Digitized by Google

water to which the cattle have access for drinking. This question has been discussed at some length in a previous report, where I have shown clearly that the introduction of various animal parasites, and consequent unfavorable results, are in most cases directly traceable to contamination of the supply of water or food furnished the cattle.

From another standpoint this matter becomes even more striking. It is well known that the large production of an article inferior in grade is not financially so satisfactory as the production in smaller quantities of the same article of high grade. The presence of parasitic animals, by reducing the vitality and preventing the accumulation of flesh, distinctly lowers the quality of the whole, and makes the product worth less on the market than were it free from such infection. Of course this is a loss which is difficult to appreciate so that its actual occurrence is doubted or denied by many. It is none the less true, however, that the food which is abstracted by the parasite for its own support cannot go to the good of the animal, and that the irritation which the presence and movements of the parasites cause makes the host nervous, with corresponding loss in general tone.

There is, however, at least one aspect in which the financial loss is thoroughly appreciated by the cattle raiser whether he is in business on a large scale or in a more limited way. The United States laws provide that all meat which is killed for foreign or inter-state trade must be submitted to examination to insure its satisfactory condition, and if it is not able to stand the test the part or even the whole animal is rejected as unfit for food. That the loss entailed is considerable may be gathered from the recent report of the Secretary of Agriculture concerning meat inspection for the year ending June 30, 1896. In the Year book of the U. S. Department of Agriculture for 1896 (page 19) occurs the following table concerning the post-mortem inspection of animals:

	NUMBER OF INSPECTIONS.			CARCASSES CONDEMNED.			PARTS OF CARCASSES CONDEMN'D AT ABATTOIRS.
	At Abattoirs	On animals condemn'd in stock yards.	Total.	At Abattoirs.	Stockyards Inspection.	Total.	
Cattle.....	3,985,484	9,977	3,995,461	4,886	3,871	8,757	6,798
Sheep.....	4,629,796	3,546	4,633,342	2,794	1,541	4,335	242
Calves.....	256,905	931	257,836	276	761	1,037	33
Hogs.....	14,250,191	28,028	14,278,219	31,178	15,011	46,189	33,930
Totals...	23,122,376	42,482	23,164,858	39,134	21,184	60,318	41,003

It is a conservative estimate to value the cattle at $50 per head, the sheep at $5, the calves at $15, and the hogs at $10, making the value of the condemned carcasses of cattle, $437,850, those of sheep, $21,675, those of calves $15,555, and those of hogs $461,890, or a grand total of $936,970 for all carcasses condemned. To this must be added something for the 41,000 parts of carcasses which were separately condemned, so that the entire loss may be placed by this conservative estimate at *not less than $1,000,000 in a single year.* But the cattle which are sent to these slaughtering

Digitized by Google

places are, as a matter of fact, decidedly above the average grade, while the poorer grade of animals is dressed at local and private abattoirs at which as yet no inspection is carried out. Here the percentage of unwholesome parts is unquestionably much larger, and consequently the rate of loss equally so.

A similar compulsory examination exists at present in other civilized countries for all meat which is to be offered for sale, and will certainly be introduced gradually by the various state authorities as a means of protection for their own citizens. Certainly the welfare of the inhabitants of a state is too immediate a charge upon the officials of that state to permit their laxity in this respect. We have no wish in Nebraska that through the greed of individuals or corporations or the dishonesty of sellers there should be offered for sale meats which cannot pass muster for inter-state or foreign traffic.

To prevent the loss consequent upon infected meat it is necessary that we should know what parasites are present within our borders and how frequently each particular kind is likely to be found, what are the specific dangers attending its presence, and what means should be taken to prevent its introduction into uninfected animals and ultimately to eradicate it from our fauna. In previous volumes of the Annual Report of the State Board of Agriculture I have given extensive descriptions of the parasites which are likely to be found, of the dangers which attend their presence, and of the means for their prevention. Especial emphasis has also been laid upon the fact that, in some cases, prevention is the only possible remedy, since a cure is out of the question, and that in all cases it is much cheaper, as well as better, to keep out the parasites rather than endeavor to remove them after they have been introduced.

The confusion which has attended the study of parasites hitherto is, in large part, due to the difficulty of determining with what species we have to deal in a definite case. From their somewhat uniform external appearance the identification of a particular form is rather difficult, especially since inaccurate descriptions have introduced much confusion. I have previously recorded in the Report for 1894, 1895, and 1896 about twenty-eight important parasites of domesticated animals which are present in the state, and many of which have, at one time or another, and in some locality, occasioned epidemic and serious loss. All records of the presence of parasites in the state are evidently important, and such as are of that permanent character that the specimens are preserved and the accuracy of the record may be tested at any time have a peculiarly high value. Thus it was that, with pleasure, I accepted the courteous invitation of Dr. A. T. Peters to review the parasites which were preserved in the collection of the Patho-Biological Laboratory at the Experiment Station here, to make an accurate determination of them and to record in permanent form in this report those parasites which were present. It should be said that the forms which are preserved in this collection are peculiarly important since, in a large majority of cases, they were obtained from animals which were subjected to post mortem as the result of fatal attacks of dis-

Digitized by Google

ease in a considerable per cent of which, at least, the disease, or at least the debility, of the animal is directly traceable to the presence of parasites. Many of the specimens were also sent from various localities in the state with the information that the animal from which they were obtained was one of a number affected with worms so seriously as to need attention. In regard to a few, the direct connection between the malady and the parasite could be positively demonstrated. A detailed consideration of this collection constitutes the second part of this report.

The problem of raising pure meat involves, then, a full knowledge of the dangers to which animals may be unwittingly exposed and the protection from these dangers afforded by correct hygienic conditions. Evidently in a new country, when the fields are as yet uncontaminated, conditions exist which are the most favorable; but if in any way parasitic infection is introduced and the forms find congenial environment for development through carelessness of the stock raiser, it does not require long for the parasite to acquire a hold on the locality which can be broken only by long continued labor and at considerable expense. English sheep raisers found, for instance, that the sheep liver fluke (*Fasciola hepatica*) once introduced, became, under favorable circumstances, so abundant as to cause epidemics, which, even in a single year, carried off sheep to the value of $20,000,000. Many of the old sheep feeding grounds had to be entirely abandoned; in others, expensive treatment was necessary before the land could be made use of again for this purpose. The industry was consequently almost destroyed in certain regions. There is only one satisfactory means of dealing with parasitic diseases and that is prevention.

The pure meat problem has, however, at least one other factor. It must not only be kept during life under satisfactory conditions, but these must continue until it is in the hands of the consumer. In other words, pure meat must not only be *well raised;* it must also be *well killed.* No matter how great the care bestowed upon it earlier, this care must not be relaxed at the end. To be sure, this factor does not concern the producer seriously, since his results have been attained when the fattened cattle are finally sold. It is, however, of the greatest importance to the consumer, who has a right to demand that the meat shall be prepared under the most satisfactory conditions which are obtainable. For his sake the final stage must be carried out in such a way and under such circumstances that the food shall be thoroughly wholesome and free from any taint whatsoever. Any shortcoming in this feature will necessarily largely, it may be even entirely, negative the beneficial results attained by the stock raiser and make of that which would be otherwise an article of high grade one which is, as a matter of fact, mediocre in character.

The final factor in the problem of pure meat production is found in the place at which the animals are slaughtered for food. This has been most admirably presented by Dr. Stiles in an article on The Primitive Slaughter Houses as a Factor in the Spread of Disease, which was printed in the Year Book of the Department of Agriculture for 1896. In this article is

Digitized by Google

discussed most clearly the relation in which the slaughter house stands to public health, and the necessity that all such places should be controlled by the State Board of Health in order that all meats may be inspected at the time of slaughtering, thus securing for the locality concerned a guarantee as to the satisfactory condition of the meat. The article also clearly shows that such diseases as trichinosis, echinococcus disease and other troubles caused by animal parasites, as well as tuberculosis, hog cholera, swine plague, and other bacterial diseases, are disseminated from these local slaughter houses as centers by offal feeding, drainage, rats, and dogs, and that furthermore, under satisfactory regulations, these diseases may be not only held in check, but often even completely eradicated.

I had occasion in the report last year to call attention to the fact that the large slaughter houses, in connection with the packing establishments of our state were undoubtedly the chief factor in accounting for the extreme rarity or entire absence of the more dangerous parasites of dogs in this part of the world, since the complete utilization of all parts of the animal slaughtered results in the destruction of the larval stages of those parasites which are present, and thus prevents their reaching the ultimate host in which sexual maturity is attained and reproduction takes place. Such establishments, then, are genuine aids to the development of civilization and direct agents in the realization of those hygienic conditions of life for which students of the subject are striving. There is one conclusion stated by Dr. Stiles to which I give most hearty assent as the results of my own observation in this state, and desire to emphasize it as strongly as possible by quoting it in this connection:

"The country slaughter house is more injurious to the farmer than to other classes as he is less able to meet the dangers involved, and, on this account, he is urged to take the initiative in calling for a better regulation of places of slaughter."

THE COLLECTION OF PARASITES AT THE PATHO-BIOLOGICAL LABORATORY.

This collection embraced a considerable number of bottles of specimens which have been collected under Dr. Peter's supervision within the past two years. A few were of older date, but the specimens were in many cases unsatisfactorily preserved and in such a condition that an accurate determination was impossible. No reference to the most of these can be made since an incomplete or inaccurate determination is a hindrance rather than a help to work along this line. The specimens which had been collected under Dr. Peter's supervision were in satisfactory condition; they belong to five species of cestodes and eight of nematodes, of which the more important are the following:

Digitized by Google

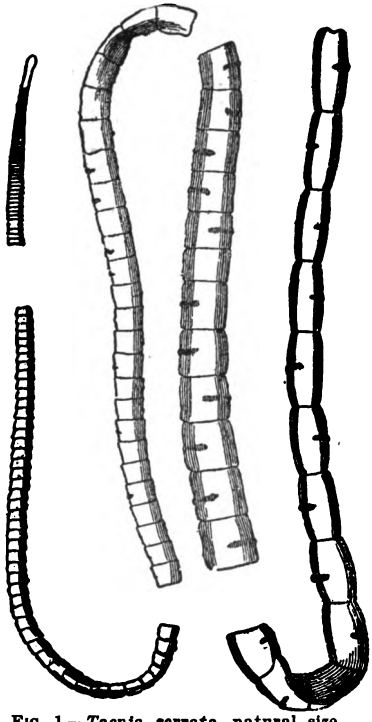


FIG. 1.—*Taenia serrata*, natural size. [After Railliet.]

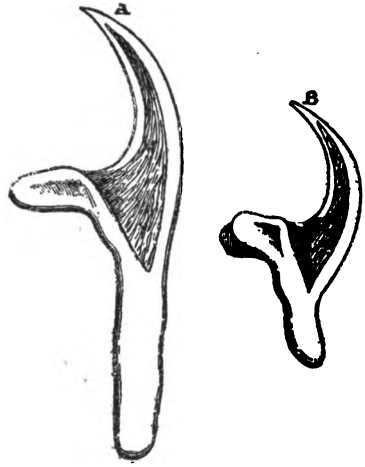


FIG. 2.—Hooks of *Taenia serrata*. x 250. [After Railliet.]

a. Taenia serrata.

This common species, which, as the statistical review of the parasites of dogs and cats examined in Lincoln, and presented in the last annual report will show, is exceedingly abundant in this vicinity was represented in the collection by adult tape worm. The larva, which is the small bladder worm of the rabbit (*Cysticercus pisiformis*) has also been found in the tame rabbits which have been bred for experimental purposes at the laboratory. I have in my own collection a number of specimens of the larva, which were sent me for examination from the laboratory.

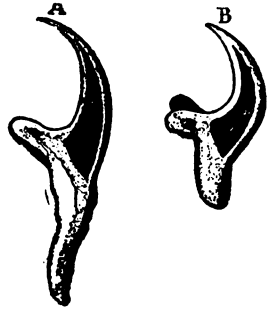


FIG. 3.—Hook of *Taenia serialis*, x 250. [After Neumann.]

b. Taenia serialis.

This species of tape worm was described at length in the Report for 1896, page 183. The adult was not found in the collection of the Patho-Biological Laboratory, but there were a number of extremely fine specimens of the larva (*Coenurus serialis*) which is the large bladder worm so abundant in the wild rabbits of this vicinity. One specimen of this bladder worm deserves particular mention as the finest cyst

Digitized by Google

that I have ever seen. It was at least ten centimeters in length involving both the kidneys and superjacent peritoneum of a rabbit. The primary bladder was somewhat branched and contained five or six large secondary bladders, varying from one-half an inch to an inch and a half in longest diameter, and abundantly supplied with heads. The specimen bore considerable resemblance to the *Echinococcus* bladder, for which it would be easily mistaken except as close examination was made of the individual heads. These, however, at once betray the specific character of the form as their shape and large size render them very distinct from those of the *Echinococcus.*

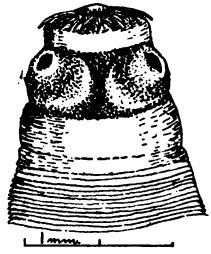


FIG. 4.—A Head of *Taenia crassicollis.* x12 [Original.]

c. Taenia crassicollis.

The thick-necked tapeworm of cat was represented by several typical specimens. One bottle contained half a dozen specimens which were taken from a cat that had died in the fall of 1896 from unknown causes. This number of tapeworms is rather large, being the most recorded from a single host for this vicinity. There was, however, no further evidence of any pathological effect in this instance.

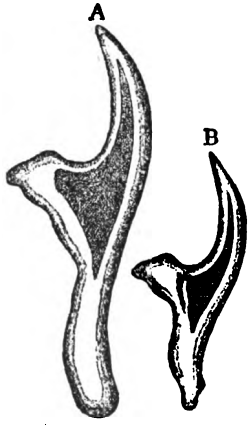


FIG. 5.—Hooks of *Taenia crassicollis.* x125 [After Neumann.]

Nematodes.

d. Ascaris lumbricoides.

The common round worm of the pig is very abundant in the state and is represented in this collection in a number of vials. In at least one instance it was specifically noted that on the farm from which these specimens came, there was much trouble among the hogs on account of the abundance of the worms. The only noteworthy thing beyond the number of specimens found in the collection is the fact that many of them were unusually large and approached the limits of size (25 cm.) given for this species by various authors. It should be remembered that this is the common thread worm of children and one author has recently shown that children

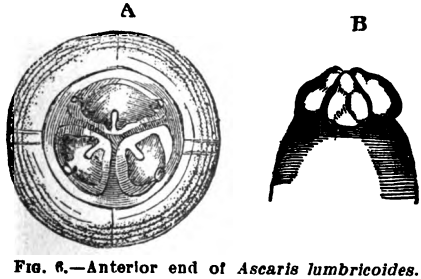


FIG. 6.—Anterior end of *Ascaris lumbricoides.* *a*, front view; *b*, side view.

Digitized by Google

may actually become infected with the parasite while playing in localities where the pigs have been. It is probably definitely settled that no intermediate host is necessary for the development of the parasite, but that eggs which have lain under proper conditions of moisture and warmth for a month or less are capable of attaining full development when introduced into the host. This introduction may take place with drinking water, by accident with dirt or dust, or on the surface of uncooked vegetables. To these should be added in the case of children all objects, such as sticks, blades of grass, and other articles which are likely to be chewed by the child. It is necessary, then, for the health of the family that the parasites should not be present on the farm. On the basis of direct development, one can understand also the abundance of the parasites among pigs, for the eggs find in the droppings the necessary conditions for their development, and the embryos are introduced in quantities by the rooting of the pigs among the refuse of the sty.

e. Ascaris equorum.

This round worm, or maw worm, of the horse is the largest of all the group and easily recognized by its considerable size, and by the three prominent lips surrounding the mouth. The presence of this species in the state, which was suspected from various accounts mentioned in a previous report, is established by the existence of a bottle of fine specimens in this collection. The worms are typical and were taken from the stomach of a mare which died at the farm from colic in 1896. The species was associated with *Spiroptera microstoma*, which will be mentioned later. The worm is also said to exist in considerable numbers on the upland pastures in the center of the state and to be exceedingly troublesome to the horses at certain seasons of the year.

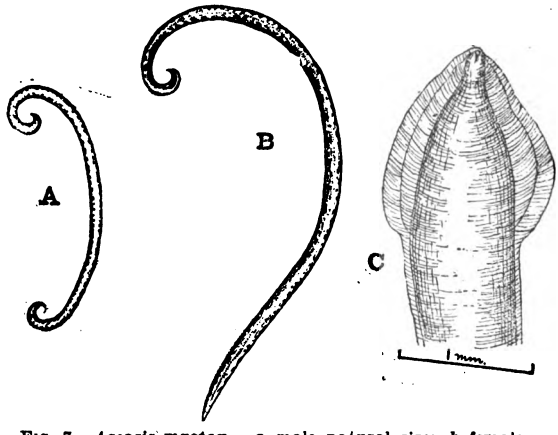


FIG. 7.—*Ascaris mystax*. *a*, male, natural size; *b*, female; *c*, head magnified, showing lateral wings. [Original.]

f. Ascaris mystax.

Specimens of this round worm of the cat and dog were numerous in the collection. Most of them are old, badly macerated, and without designated host. It is fair to assume that they may have come from those mentioned in which they are abundant in the state at other points. The specimens were in too unsatisfactory a condition for the determination of the different varieties.

Digitized by Google

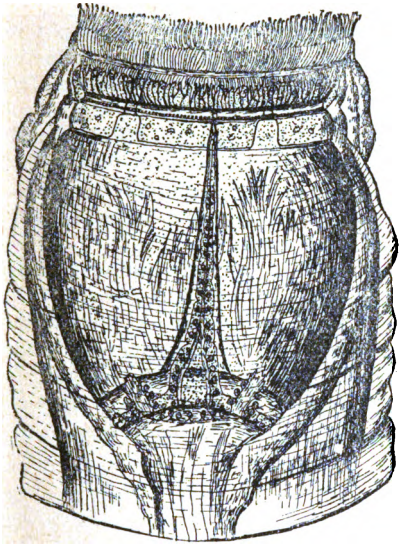


FIG 8.—Head of *Sclerostoma equinum*, showing the rows of stout bristles surrounding the opening of the oral capsule and the median ridge. [Orig.]

g. Heterakis.

One bottle of the collection contained a few specimens of a species belonging to this genus, but too badly macerated to hazard a guess as to their specific identity. They had been taken from a chick which had died of diphtheria.

h. Sclerostoma equinum.

The armed Strongyle of the horse, as it is commonly called, is one of the most dangerous parasites of that animal. The first record of its occurrence in the state was given in the Report for 1896. A single vial of well-preserved specimens occurred in the collections of the Patho-Biological Laboratory. The specimens were all females of the larger variety, measuring 40 to 50 mm. in length. They had been taken from the caecum of a mare that had died in 1897 from colic. The connection between the parasite and the disease is too evident to require further demonstration. The species has been fully discussed in the reports for 1894 and 1896.

FIG 9.—Portion of wall from Caecum of horse showing tumors of different sizes due to *Sclerostoma*, as well as the parasites fastened to the mucous membrane. The two varieties of *Scl. equinum* are shown at the right, while those of *Scl. tetracanthum* appear on the left; two-thirds natural size. [After Railliet.]

The dangerous character of this parasite and the impossibility of a cure for those animals which are attacked, make it imperative that great care should be exercised in reference to the source of drinking water furnished to horses. That taken from deep wells and piped directly to some elevated drinking place is in all respects the most desirable. All infected animals should be isolated as soon as discovered, and the droppings from them destroyed, lest infection be spread by chance to other animals.

Digitized by Google

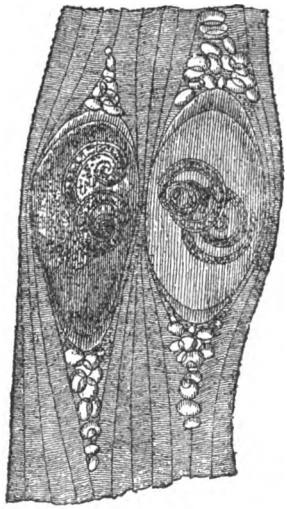


FIG. 10.—Muscular tissue containing encysted *Trichinae*; the right cyst contains two worms. [After Colin.]

i. Trichinella spiralis.

The common trichina of the pig was abundantly represented in the collection. Several bottles of test pieces taken from the muscles of various pigs were included in the collection. These specimens differ in no way from the normal form. Their presence merely denotes the general occurrence of the species in animals slaughtered in this locality.

Investigations are now on foot concerning the abundance of this parasite in the state, the generality of its distribution, and the means by which the pigs become infected. It is hoped that next year full and precise information can be given on these most important questions.

j. Spiroptera microstoma.

A bottle of worms which are identified as this species occurs in the collection. They were said to have been taken from the stomach of a mare which died of colic in 1896. This is the same one from which the specimens of *Ascaris equorum* were obtained. As the species has not been recorded in this vicinity before, I append a short description with illustrations. The worms were so abundant in the contents of the stomach that their number could not even be estimated, and only a few were picked out for preservation.

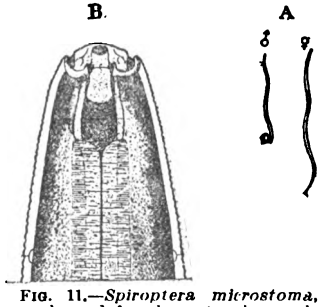


FIG. 11.—*Spiroptera microstoma*, *a*, male and female, natural size; *b*, anterior end, x100. (After Neumann and Railliet.)

Mouth with two lateral lips and two prominent teeth, a dorsal and a ventral. Male 10 to 22 mm. long, with tail curled in short spiral and provided with small membranous wings and two unequal spicules. Female 12 to 27 mm. long; tail straight, blunt; vulva in anterior third of body; eggs 0.045 to 0.049 mm. long by 0.016 mm. broad.

These small, round worms occur free in the stomach of the horse and mule. Certain authors believe that their presence is accompanied by an inflammation of the gastric membrane. They are at times encountered with the head end buried in the glands of the wall. Their pathological importance is uncertain.

Digitized by Google

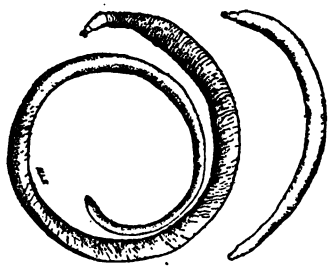


FIG. 12. *Gigantorhynchus gigas* from Lincoln; male at left, female at right. Half natural size. [Original.]

FIG. 13. Head of *Gigantorhynchus gigas;* magnified. [Original.]

k. Gigantorhynchus gigas.

The spiny headed round worm of the hog, which is found associated with *Ascaris lumbricoides* is in accordance with its abundance in this locality represented by numerous bottles in the collection. It has been well described in the report for 1894. The specimens found were normal and represent the maximum size attained by the species, certain individuals measuring as much as 36 cm. in length. Some specimens had been preserved with the head buried in the intestinal wall where there could be seen nodules the size of a pea or somewhat larger that had evidently been produced by the irritation. The proboscis had penetrated so far in a few cases as to show that the piercing of the wall was practically completed.

INTERNAL PARASITES OF CHICKENS.

The studies which were begun last year with reference to the numbers and kinds of parasitic worms in domesticated birds have been continued. The following table includes a synopsis of the examinations which have been made in Lincoln and vicinity during the year; both actual numbers and percentages are given. During the past summer one of my students was able to examine a number of birds in a neighboring state for comparison with conditions which exist here, and the results of his examination are listed in the same table:

Digitized by Google

	Total number examined.	Free from parasites.	With Cestodes alone.	With Nematodes only.	With both.
In Nebraska, 1896	162	102	14	34	10
In Nebraska, 1897	137	50	33	15	39
Total	299	152	47	49	49
In Iowa, 1897	22	5	5	3	9
Percentage.					
In Nebraska, 1896		*63*	*9*	*21*	*6*
In Nebraska, 1897		*36*	*24*	*11*	*29*
In Nebraska, Total		*51*	*16*	*16*	*16*
In Iowa, 1897		*23*	*23*	*14*	*40*

A second table shows still more clearly the degree of infection in various cases.

	IN NEBRASKA.		IN IOWA.
	1896	1897.	1897.
Average number in each chick infected			
Of Cestodes	7	18	*22
Of Nematodes	4	4	8
CESTODE INFECTION.			
Numbers of hosts infected			
Each with few (1-4)	14	24	3
" " average (5-10)	6	13	2
" " many (20-31)	3	11	*9
" " (100*)		2	1
NEMATODE INFECTION.			
Number of hosts infected			
Each with few (1-3)	30	39	5
" " average (4-8)	6	10	3
" " large number (12-16)	3	4	2
" " (25-50)	2		1

* Partly estimated.

Digitized by Google

A critical study of the results of these examinations shows a number of points of considerable interest. In the first place with reference to the abundance of the different kind of parasites. Of the birds examined in Nebraska only two contained over a hundred cestodes each, while thirty-eight contained less than four each. For the nematodes only nine chickens contained more than ten worms each, while in sixty-nine the number was less than three each. Compared with those collected from the neighboring state, it is at once apparent that a much larger percentage of the Nebraska birds is entirely free from parasites and that, while the percentage of hosts infected with one or both kinds of parasite is clearly less for Nebraska than for the other state, it is still more striking that the average number of parasites is decidedly less for each host here than in the birds examined elsewhere. This decided advantage on the part of our state finds its explanation probably in the newer condition of the country, the uninfected character of the fields and water supply, and in the somewhat drier climate which we enjoy.

A further fact of some importance becomes apparent when we compare even roughly the ages of the birds examined. Of Nebraska chickens 162 were classed as full grown; among these 102, or 63 per cent, were free from parasites; 14 or 9 per cent with cestode alone, 34 or 21 per cent with nematodes alone, and 10 or 6 per cent with both. Ninety-seven were of uncertain age and among these 43 per cent were free from parasites, 16 per cent were infected with cestodes alone, 13 per cent with nematodes alone, and 25 per cent with both. Forty chickens were distinctly not more than half grown; among these 7, or 18 per cent, were free from parasites; 17 or 42 per cent were infected by cestodes alone, 2, or 5 per cent, by nematodes alone, and 14, or 35 per cent, by both.

Among the birds of the neighboring state the results were still more striking. Here a personal acquaintance with the barnyards from which the chickens came made it possible to determine more closely the age. Two which were classed as very old did not either have a single parasite, and one which was full grown was only slightly infected. Of the ten which were approximately a year old, 7 were infected, three only very slightly, and the three others not at all. Of the nine which were not three-quarters grown, every one was infected. They also furnished the instances of the worst infection. As these birds were examined in a very limited locality and within two weeks of the same time, it is evident that differences due to time of year or other peculiarities of enviroment were practically eliminated. Such differences may have played a certain, but unknown, part in the case of those birds examined in Lincoln where the examinations were extended over some time, and where the birds came from many different localities. Both sets of observations, however, appear to point perfectly distinctly to the greater liability to parasitic infection which the younger forms show or to the less favorable conditions for development presented in the alimentary canal of the older individuals.

A further fact with reference to the influence exerted by the age of chickens on the number of parasites is shown by a comparison of the dif-

Digitized by Google

ferent relative frequence of different kinds of parasites. Thus, of the full-grown chickens, 9 per cent were infected with cestodes; among chickens doubtful in age 16 per cent harbored cestodes and among half-grown chickens 42 per cent. So that the liability of the chick to cestode infection decreases with growth. If the numbers which represent the nematodes be considered, it will be seen that the reverse is true. But 5 per cent of the half-grown chickens harbored these parasites, while among those of doubtful age the percentage of infection is 13, and among the full-grown it has increased to 21 per cent. As the figures cover 299 birds killed at various seasons of the year, it is altogether probable that these results represent a real tendency and are not mere accidental coincidences. It may of course be, however, that the results depend upon habits which are associated with a given age rather than any difference in susceptibility which is modified with the growth of the host.

Among the most common of the poultry parasites are the two following species of tapeworms which, with the round worm parasite described and figured last year, constitute the largest part of the parasitic forms found in the birds of this locality. Other forms exist, notably the species described by Conard * and figured by Stiles in his report, but they are so infrequent as to play, at most, a small part in the infection of the birds. For convenient reference I append a short description of the frequent species.

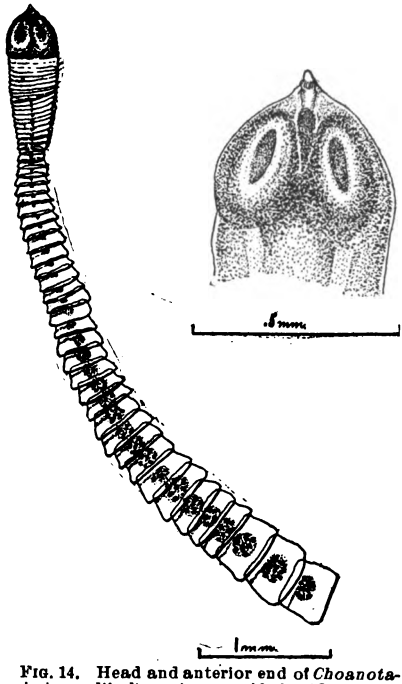


FIG. 14. Head and anterior end of *Choanotaenia infundibuliformis*, magnified. (Original.)

Choanotaenia infundibuliformis Railliet 1896.

SYN.—*Taenia infundibuliformis* Goeze 1782; *Drepanidotaenia inf.* Railliet 1893.

In length 20 to 100 mm., or somewhat more. Head (Fig. 14) 0.350 to 0.415 mm. in transverse diameter with cupola-shaped projecting rostellum, armed with 18 to 20 small hooks 0.02 to 0.025 mm. in length, arranged in a single row. Neck wanting or very short. Anterior segments short, becoming soon funnel-shaped and as long as broad. Genital pores irregularly alternate.

* Mr. Conard was kind enough to send me his manuscript for examination and some specimens of the species on which he worked. I was, however, unfortunate in not obtaining a head on the few specimens of this species which came to light here, and am equally uncertain, as he is, concerning its correct position. The general appearance of the worm is, however, so distinctive that, once seen, it will always be recognized again. It is to be hoped that the author cited will finish his studies on this interesting form.

Digitized by Google

Parasitic in chickens, ducks, quail, pigeon, and sparrow in various localities. Found in Nebraska thus far only in the domestic chick.

The peculiarity of this form was noted by Railliet as early as 1893 at least, and in 1896 he founded a new genus for its reception. I cannot accord with the protest of Stiles who thinks the form too little known to warrant such a step. It is certainly sufficiently accurately described to enable one to pronounce it clearly different from the other species in the original genus. I agree with its separation from *Drepanidotaenia*, and hence accept the name for the new genus given by Railliet. There is, to be sure, much which should be ascertained concerning its precise structure, and the view of Stiles that the specific name is really a collective one which shows the ignorance or inaccuracy of careless observers in grouping together forms really separate may well be true also. So it is that in the absence of sufficient original material for accurate comparison I place under the specific name this form common here. There are numerous minor points in which the species at hand does not correspond with existing descriptions of the species as given European writers, but the agreement is so great that in the absence of detailed studies on the originals I prefer to refer it provisionally to the well-known form rather than add to the confusion by establishing a new species to include it.

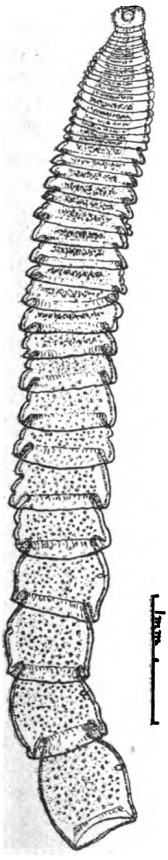


Fig. 15. *Davainea cesticillus* x9 (Original.)

Davainea cesticillus R. Bl. 1891.

Syn.—*Taenia infundibuliformis* "Goeze 1782" of Dujardin 1845; *T. cesticillus* Molin 1858.

From nine to forty-five mm. in length, or even up to 130 mm. according to other authorities. Head globular (?), or flattened 0.5 to 0.55 mm. broad, rostellum convex, or hemisperical, not prominent, 0.28 to 0.32 mm. broad armed with double crown of 208 hooks, 0.007 to 0.009 mm. long; these hooks fell off very easily; suckers 0.01 to 0.011 mm. in diameter not at all prominent.

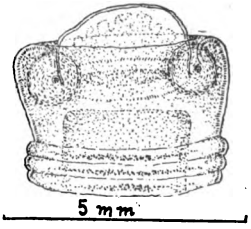


Fig. 16. Head of *Davainea cesticillus* x64. (Original.) The scale should read 0.5 mm.

Neck wanting or very short. Anterior segments three to five times as broad as long; the following increase in size until they become equal in length and breadth; borders overlapping. Elliptical eggs 0.075 to 0.08 mm. long; hooks of onchosphere (embryo) 0.016 to 0.023 mm. long. Genital pores irregularly alternate.

Parasitic in chickens. Common in France, Italy, Denmark, Abyssinia, Turkestan.

Digitized by Google

So far as can be determined without an exhaustive study of the type specimens the form found plentifully in chickens in this vicinity belongs to this species. There are many respects in which the description which is quoted from various sources unquestionably need emendation; other points of difference may be attributed to the confusion existing in the species of this genus.

As regards the length I have specimens from 9 to 68 mm. all apparently matured and having released proglottids. Many of intermediate length are clearly broken specimens since the terminal proglottids are not yet ripe. The specimen figured is one of the shorter ones. The shape of the head is poorly described by the term "globular" which is generally employed; Dujardin adds also "flattened," and this contributes much to correctness. As a matter of fact, the shape of the head varies greatly in different conditions of extension or retraction; the extremely contracted form is shown in figure 15, while figure 16 presents the organ as half expanded. The change is really due to the position of the rostellum, which is highly motile and hardly assumes the same form in any two specimens. The head proper is shaped like a thickened ring, measuring in my specimens from 0.37 to 0 56 mm. in width, and from 0.2 to 0.4 mm. in height, excluding the rostellum. The four suckers are inconspicuous and often invisible; they measure 0.1 to 0.12 mm. in diameter. I take the size given by Dujardin and quoted by Railliet and Stiles, namely 0 01 to 0.011. mm., to be an evident typographical error.

The rostellum is a hemispherical muscular mass occupying the anterior part of the head, and measuring from 0.26 to 0.35 mm. in transverse diameter and 0.09 to 0.18 mm. in thickness. It may be deeply retracted when it is often hollowed out in the center and presents precisely the appearance of a prominent median sucker such as is said by some authors to be present at the apex of the head in this or closely related species. When fully extended it appears as a dome of muscular tissues projecting from the head. A deep furrow entirely surrounds it and even cuts in slightly underneath. The hooks which are reported to be normally 208 in number are very easily lost; they are entirely absent from many of my specimens and only a few occur in any. In size they vary from 0.007 to 0.01 mm.

The relative proportions of segments from various regions of the chain are indicated in the figure, and from it one can also see clearly the position of the genital pores. In the specimens studied here the elliptical eggs measure on the average 0.08 mm. and the inner shell 0.045 mm. in length.

FISH FOOD IN NEBRASKA STREAMS.

The province of the zoologist of the Board of Agriculture is, however, not confined to the study of animal parasites. The other forms of animal life, exclusive of the insects, which belong to the entomologist, come equally within his sphere. During the past year there has been inaugurated a series of examinations of the waters of the state with reference to the animal life which they contain and their consequent value in the supporting of those large forms, peculiarly the fish, which are useful as food.

Digitized by Google

The state has devoted each year a considerable sum of money which has been wisely expended under the able direction of its fish commission for the propagation of fishes, and for planting the various waters of the state with such forms of fishes as seem best suited to the conditions which obtain here. It is, however, at once apparent that some biological studies of the water should be made in advance of or in connection with this work, for however desirable in general appearance the locality may be in which the fish are planted, it is evident that unless the supply of fish food in the water is large enough and can multiply itself rapidly enough to meet the increased depletion in numbers due to the feeding of the fish, the stocking of the waters will not be permanently successful, but that the fish will within a short time, exhaust the food supply and themselves perish from starvation. This is known to have been the case in some of the older states where the process of stocking has been carried on long enough. It is evidently desirable, then, that the precise information must be sought with reference to three points: first, what constitutes the food of fishes; and, second, what of that is present in the various waters of the state and in what abundance; third, to what extent can this food multiply if it be depleted by the feeding of a considerable number of fish which have been newly introduced. It is my object to consider here this year the first question merely and to recount the steps which have been taken towards seeking a solution of the second and third.

The problem with reference to the source of food supply for fish is decidedly unlike similar problems in reference to our ordinary domesticated animals. Those of the latter which serve us for food are almost without exception herbiverous. Their supply of food comes from the various grasses and grains which draw their support directly from the inorganic materials contained in the earth, air, and water. Not only is the series of relations between the inorganic substance and the article of human food short and simple, but it has been subject to careful study by workers in many scientific institutions and on experimental fields until much is known concerning the details of the process. Thus the preparation and enrichment of the soil, the development of the seed, the growth of the plant, the diseases and dangers which attend it, the means for its protection and improvement, all undergo constantly investigation from various standpoints. On the other hand, fresh water contains few large plants and not even these serve as nourishment for the fish, for the latter are almost exclusively carnivorous, and the forms on which they live are so small as to have escaped notice in large part, yet they atone for their minuteness by their excessive abundance in numbers.

It is a fundamental consideration that primarily all animal life depends upon plant life for its sustenance, so that, even though the fish are carnivorous, their relation to the plant life of the water is removed but a single step, and it is necessary that concerning the primitive food supply there should be ascertained the various possible stages in reaching the fish, together with the abundance and distribution of each element in this series of forms; for unless this primitive food supply be abundant the re-

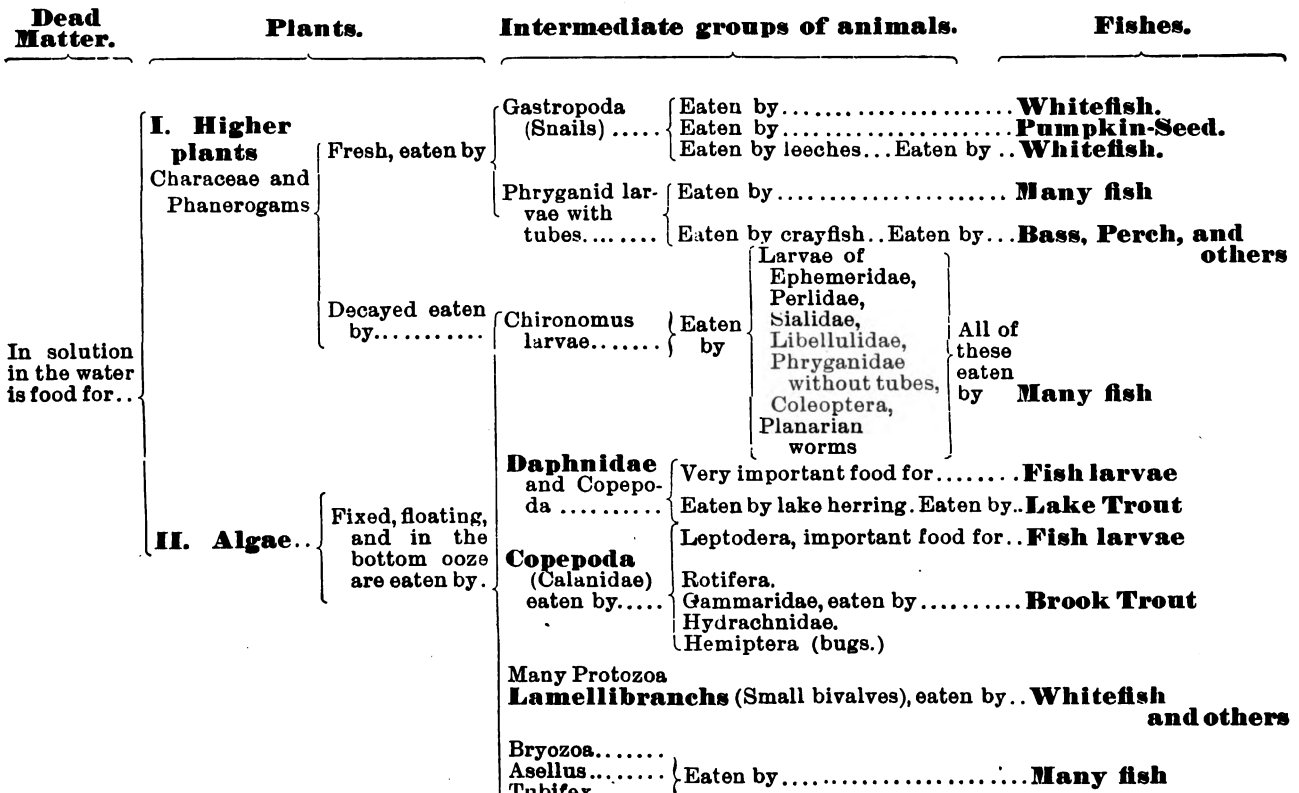
Digitized by Google

sults which follow stocking the streams will be only temporary, and unless every element in the series is capable of standing the depletion which results from the introduction of the new fish the ultimate result can be only the starvation of the fish. It is important, then, that we should understand some of the complicated relations which exist among the smaller animals of the water. These are very well portrayed by Professor Reighard in a bulletin of the Michigan Fish Commission, and the table which represents his summation of the question is reproduced on the opposite page.

The main features of the conditions represented in the water will be apparent from the study of the table. The minute plants which are the source of food supply floating in enormous numbers in the water find in it in solution those substances which serve them as food. They swim, as it were, in a nutrient fluid, and by virtue of their small size and simple organization multiply with incredible rapidity, furnishing abundant food for various small animals among which the chief forms are the single celled animals, or protozoa, the wheel animalcules or rotifers, and the minute crab-like forms or entomostraca, together with the somewhat larger mollusks and insect larvae. Among these forms not a few are carnivorous and prey upon the smaller animals, while, together these constitute the food of the fishes, some being eaten by one group of fishes, some by another. The most important fish foods, however, are the entomostraca and insect larvae. Evidently the number of these which is present and which can serve as fish food and the rapidity of their multiplication as they are being eaten up depends upon their own food supply, upon the number of smaller forms, of which themselves the same may be said, so that the chain of relations descends backward in unbroken continuity to the simplest of all, the primitive plants; hence in determining the ultimate fertility of an area of water, it is necessary to investigate all these factors, and to determine accurately the entire series.

Most of these organisms are comparatively minute. They are found floating in the free water and even, in the case of these animals which possess the power of locomotion, are able by their greatest efforts to travel only to a limited extent, and cannot influence materially their position in the water. Their surroundings are, hence, comparatively fixed, or, if changed at all, are modified by the currents, waves, or winds, and not by their own efforts. They pass their lives floating in the open water and as floating organisms have received the name of the Plankton. This Plankton constitutes in a mass the fundamental source of food supply for water-living forms. The contrast thus between conditions of life on land and in the water is very striking. On the land these are based on the large fixed plants; in the water these do not exist, while life is dependant upon a mass of minute floating organisms. Among them growth, reproduction, and death succeed one another extremely rapidly; myriads are born and myriads die with every minute of time, so that under normal conditions their number remains comparatively constant. The amount of this float-

Digitized by Google


Dead Matter.
Plants.
Intermediate groups of animals.
Fishes.
In solution in the water is food for..
I. Higher plants Characeae and Phanerogams
Fresh, eaten by
Gastropoda (Snails) .....
Eaten by..... Whitefish.
Eaten by..... Pumpkin-Seed.
Eaten by leeches...Eaten by .. Whitefish.
Phryganid larvae with tubes.....
Eaten by..... Many fish
Eaten by crayfish..Eaten by... Bass, Perch, and others
Decayed eaten by.....
Chironomus larvae.....
Eaten by
Larvae of Ephemeridae, Perlidae, Sialidae, Libellulidae, Phryganidae without tubes, Coleoptera, Planarian worms
All of these eaten by Many fish
II. Algae..
Fixed, floating, and in the bottom ooze are eaten by.
Daphnidae and Copepoda .....
Very important food for..... Fish larvae
Eaten by lake herring. Eaten by.. Lake Trout
Copepoda (Calanidae) eaten by.....
Leptodera, important food for.. Fish larvae
Rotifera.
Gammaridae, eaten by..... Brook Trout
Hydrachnidae.
Hemiptera (bugs.)
Many Protozoa
Lamellibranchs (Small bivalves), eaten by.. Whitefish and others
Bryozoa.....
Asellus.....
Tubifex.....
Eaten by..... Many fish

Digitized by Google

ing matter or Plankton which exists in various regions has been the subject of extended investigations both in the Old and the New World, but these investigations have been confined for the most part to lakes of considerable size which afford a constant and stable environment. The conditions which prevail in this state are somewhat different, such large bodies of water being almost entirely lacking. We have to deal with small ponds and lakes exhibiting a considerable variation in level through the year or with streams of comparatively small size. Again, only in certain limited regions of the state is the water clear and transparent, as has been the case with those regions which have been the subjects of investigation hitherto. Ordinarily there is carried in suspension a considerable amount of fine inorganic material which modifies the conditions of existence so greatly as to affect materially the kinds and amount of animal life which is present.

The first organized effort to ascertain something with reference to the amount of life existing in the waters of this state was made last September. A small party of advanced students from the Zoological Laboratory of the University of Nebraska, provided with the necessary apparatus for collecting and preserving these minute organisms, spent a week in the field examining and making collections from all bodies of water which lay along their route. The itinerary of the party may be briefly outlined as follows: Leaving Lincoln it proceeded along the Salt Creek valley to the Platte at South Bend, where a stop of one day was made, and the lakes of the bottom land along the river, as well as the springs at the state fish hatcheries, were carefully investigated. From thence overland to Bellevue where the springs were carefully studied, as well as numerous small streams which were met on the way. The next move was southward to Plattsmouth, during which a number of streams along the Missouri bottom were examined. From Plattsmouth the party turned inland to Weeping Water, and from Weeping Water to Lincoln. Along this line opportunity was found to investigate a number of streams which would serve to indicate the faunal character of the waters of this region. While the area covered was small, a considerable number of forms was collected and a good idea gained of the richness of the water fauna in this part of the state. It must be said that the results were gratifying beyond all expectations. The waters were found to be richer than had been expected and the possibilities for fish life correspondingly greater. The studies will be prosecuted further and more detailed statement made at a later time in reference to them.

As is apparent from the table given on page 275 the small crustaceans or entomostraca are very important food elements in the water. The species of Cladocera and Copepoda which occur in the vicinity of Lincoln have already been determined by studies made in this laboratory, and from these I quote, through the courtesy of the authors, the following lists of species and distribution. The lists include the major part of the forms found here, although additions will probably be made with more extended observations. The table giving the distribution of the Cladocera is taken

Digitized by Google

from a paper on the subject by Prof. Chas. Fordyce. It embraces the following species, fourteen in number:

TABLE SHOWING SPECIES OF CLADOCERA.	Lincoln.	Waverly.	Elmwood.	South Bend.	Bellevue.	La Platte.	Weeping Water.
Sididae							
Daphnella brandtiana				x	x	x	x
Daphnella citharoedica n. sp.				x		x	
Daphnidae							
Daphnia pulex				x			
Moina rectirostris	x	x	x				
Scapholeberis mucronata					x		
Simocephalus fimbriatus n. sp					x		
Bosminidae							
Bosmina longirostris		x		x			
Bosmina salinaria, n. sp		x					
Lynceidae							
Alona glacialis				x	x		
Pleuroxus denticulatus					x		
Chydorus sphaericus				x			
Alonopsis latissima				x			
Graptoleberis testudinaria				x			
Polyphemidae							
Polyphemus pediculus?						x	x

Among the Copepoda the following seventeen species occur in the waters of this vicinity on the authority of Mr. A. D. Brewer, from whose discussion the table shown on page 278 is quoted showing the distribution of the various species.

Diaptomus pallidus,
saltilinus n. sp.
sanguineus,
siciloides,
nebraskensis n. sp.
Eiseni.

Cyclops fuscus,
Leuckarti,
americanus,
navus,
elegans,
tenuicornis,
serrulatus,
fluviatilis,
pulchellus.

Canthocamptus minutus,
illinoisensis.

Digitized by Google

SPECIES OF COPEPODA FOUND NEAR LINCOLN.	Ashland.	Louisville.	Weeping Water.	Milford.	Blue River at Milford.	3 mi. E. of Milford.	DeWitt.	Salt Creek.	Hoca, stagnant pool	E. of Saltillo.	W. of Saltillo.	2 mi. S. of O st., on 27th.	Angle of B. & M. and R. I.	Bet. B. & M. and U. P., across R. I. from above	E. of B. & M., 1 mi. S. of Penitentiary.	Across B. & M. fr. above	Pond in South Lincoln.	N. W. of Salt Lake.	Salt Lake.	Pond 1½ mi. N. E. of Lincoln.	Near crossing of B. & M. with F. E. & M. V.	Pond 3 miles East of University Place.	Pond N. E. of Havelock.	Waverly, near road North.	Waverly Lakes.	8 mi. E. of Havelock.
Cyclops americanus.	:	×	:	×	×	×	×	×	×	×	×	×	×	×	×	:	×	×	×	×	×	×	×	×	×	×
C. serrulatus	:	:	×	×	×	:	×	×	:	:	×	:	:	:	:	:	:	:	:	:	×	:	:	:	:	:
C. elegans	:	:	:	:	:	:	:	:	×	:	:	:	:	:	:	×	:	:	:	:	:	:	:	:	:	:
C. Leuckarti	:	:	:	:	×	×	×	:	×	×	:	:	:	×	:	:	:	:	:	:	:	:	:	:	×	×
C. pulchellus	:	×	:	:	:	:	:	:	×	:	:	:	×	:	:	:	:	:	:	:	:	:	:	:	:	:
C. navus	:	:	:	:	:	×	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
C. fluviatilis	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	×	×	×	:	:	:	:	:	:	:	:
C. fuscus	:	:	:	:	:	:	:	:	:	:	:	:	:	×	×	:	:	:	:	:	:	:	:	:	:	:
C. tenuicornis	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	×
Canthocamptus minutus	:	×	×	:	:	×	:	:	:	:	:	:	:	:	×	:	:	:	:	:	:	:	:	:	:	:
Canthocamptus illinoisensis	:	:	:	:	:	:	:	:	:	:	×	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Diaptomus Eiseni	:	:	:	:	:	:	:	:	:	:	:	:	:	:	×	:	:	:	:	:	:	:	:	:	:	:
D. nebraskensis	:	:	:	:	:	:	:	:	:	:	:	:	:	:	×	×	×	×	:	:	:	×	:	:	×	:
D. saltilinus	:	:	:	:	:	:	:	:	:	×	×	×	:	:	×	×	:	:	:	:	:	:	×	×	:	:
D. siciloides	×	:	:	:	:	:	×	×	×	:	:	:	×	×	×	:	×	×	:	:	×	×	×	×	×	×
D. pallidus	:	×	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
D. sanguineus	:	:	:	×	×	×	:	:	:	:	:	:	:	:	×	:	:	:	:	:	:	:	:	:	:	:

Digitized by Google

In the group of the water mites (Hydrachnidae), extensive observations have been carried on for years. Appended is a list of species, collected in Nebraska by Dr. R. H. Wolcott*, except for the genus Atax, compiled from a preliminary examination of material collected.

Genus *Atax;* forms parasitic in mussels.

1. *Atax crassipes* (Müller). South Bend (Lake 1, State Hatchery).
2. *Atax intermedius* Koenike. Lincoln, Weeping Water, and Milford; in *Unio subrostratus, Anodonta grandis, A. plana, A. decora and Margaritana complanata.*
3. *Atax ypsilophorus* (Bonz). Lincoln, Weeping Water, and Milford; with the preceding.
4. *Atax stricta* n. sp. Lincoln, Weeping Water, and Milford; in *Unio jamesianus, U. undulatus, U. rubiginosus* and *U. lachrymosus.*

Free Living Water Mites.

5. *Cochleophorus vernalis* (Müller)? South Bend (Pond 8 and Lake 1, State Hatchery).
6. *Curvipes* sp. (young). Lincoln (pool near F. E. & M. V. roundhouse).
7. *Curvipes* sp. South Bend (Pond 8, State Hatchery).
8. *Curvipes* sp. Weeping Water (Weeping Water Creek).
9. *Curvipes rotundus* Kramer. South Bend (Pond 10, State Hatchery).
10. *Arrenurus* sp. (*solidus*-group). Bellevue (Wiley Pond).
11. *Arrenurus* sp. (*solidus*-group). South Bend (Pond 8, State Hatchery).
12. *Arrenurus* sp. (*albator*-group). South Bend (Pond 8, State Hatchery).
13. Nov. gen. et sp. South Bend (Lake 1, State Hatchery).
14. *Diplodontus despiciens* (Müller). South Bend (Ponds 8 and 10, State Hatchery).
15. *Eylais extendens* (Müller). Lincoln (pool on flat west of city), Milford (pool one-half mile east).
16. *Limnochares holosericeus Latreille.* South Bend (Pond 8, State Hatchery).

* Compare Wolcott, R. H., New Species of the Genus Atax in Zool. Bulletin, Vol. II.

Digitized by Google

Digitized by Google

MISCELLANEOUS.

Digitized by Google

Digitized by Google

STATUS OF IRRIGATION IN NEBRASKA.

The following table as furnished by the State Engineer, shows the number of miles of completed ditch, acres covered, acres watered, and cost to date, by counties, reported to the State Board of Irrigation.

COUNTY.	MILES COMPLETED.	ACRES COVERED.	ACRES WATERED.	COST TO DATE.
Antelope	2.1	250	200	$ 750 00
Banner	7.5	1620	995	2343 00
Buffalo	32	20000	9500	130500 00
Blaine	111.58	66250	25700	134005 00
Box Butte	5.25	4840	4740	5955 00
Boyd	6.25	200	40	975 00
Boone	1	3 0	300	1400 00
Brown	10.85	280	210	4285 00
Chase	84.85	19510	10612	32030 20
Cheyenne	156.1	39553	9437	67309 69
Cherry	17.75	2810	1730	5869 00
Custer	20.75	3565	6280	28188 63
Dawes	199.28	60458.5	6006	155210 60
Dawson	168	174200	44800	387634 35
Deuel	77.45	39515	14136	73519 23
Dundy	172.75	44040	15900	79130 40
Frontier	1.5	300	300	2490 00
Franklin	4.25	1060	90	2375 00
Furnas	32.5	220460	13660	212019 72
Garfield	12	16000	3000	25300 00
Greeley	33	12000	200	45000 00
Hall	1.5	200	100	4000 00
Harlan	2	100	35	200 00
Hayes	74.60	15090	2022	324881 84
Holt	36.33	11595	4812	4552 17
Hitchcock	92.35	15063	12215	66636 85
Kearney	8.75	4300	330	6000 00
Keya Paha	33.04	1761	723	8931 00
Keith	166.55	86140	16236	123477 00
Kimball	40.5	2065	1595	8402 00
Lancaster	.....	7	.....	150 00
Lincoln	248.77	154708	24740	282914 78
Logan	1.5	190	60	1200 00
Loup	16.5	16500 5	13420	43753 00
Platte	1	140	660	1500 00
Rock	8.75	50	15	829 00
Red Willow	5.5	4295	2675	39954 00
Scott's Bluff	160.75	84370	37130	265270 00
Saline	2	270	25	1010 00
Seward	.....	160	.....	2900 00
Sheridan	7	372	138.5	1665 00
Sioux	95.76	7127	3190	53342 30
Thomas	6.25	3415	300	4375 00
Valley	16	8750	6000	35000 00
Wheeler	35.1	12108	12108	45000 00
	2217.21	1161038	306365.50	2722233 75

Digitized by Google

ADDRESS BY W. G. WHITMORE.

[The following is the annual address of W. G. Whitmore, president of the Nebraska Improved Stock Breeders' Association, delivered at the meeting in Lincoln, January 18, 1898.]

The recurrences of the annual meeting of the Nebraska Improved Stock Breeders' Association, as the years come and go, cause in me a two-fold feeling of gratification and regret. Of gratification for the opportunity of again meeting and learning from a few, intelligent, tried, true, congenial men the lessons of another year's experience, but of regret that so few new comers avail themselves of these opportunities for social, mental, and pecuniary advancement. Energetic and self-sacrificing committees prepare attractive programs which are widely distributed, the great dailies as well as the agricultural and local newspapers generously disseminate information respecting the meetings, railways offer reduced rates, hotels keep us about as cheaply as we could stay at home, the coterie of progressive souls who long ago learned to know a good thing when they saw it hold a reunion, but seldom do a new face and voice show up. To what are we to attribute this seeming indifference on the part of the people of a great and growing state whose greatest industry—live stock—this society fosters, and whose interest these meetings are to promote? Possibly the holding in numerous localities of farmers' institutes where similar topics are discussed has something to do with it, and I must prefer to believe this is the cause rather than that our rising generation of farmers are indifferent to so vital interests as are here represented. An excellent editorial article in the last number of the *Nebraska Farmer* upon this question is very pertinent and timely, and I commend its careful perusal to every young farmer in the state.

LACK OF PUBLIC INTEREST.

Speaking of our own and similar organizations it says:

"All the work of the societies is of a public nature, for the very cause of their existence is the necessity for promoting the general good of the various branches of agriculture represented. It is assumed, therefore, that all the people are interested in the work of these societies.

"This, however, is apparently assumption only, for comparatively few of the people are members of these societies, or attend their meetings. This should not be so. Every agricultural society, whether it calls itself agricultural, horticultural, live stock, dairy, or what-not, has a valuable work to do, and is doing a valuable work. The inspiration the society gives to particular workers in any line, and keeping the work of its department of agriculture prominently before the people, is very valuable. More than this, the society accumulates the latest and best information relating to the particular branch of agriculture which it represents, and places this information before the people, either through the agricultural press, or through annual reports printed at the expense of the state. We insist,

Digitized by Google

therefore, that the interest in these societies ought not only to be general, but it should be personal to every wide awake farmer in every state.

"All cannot, of course, attend the meetings of these societies, because of the expense involved. But many more than do attend could attend if they had the will and the lively interest the existence of the society warrants.

"We urge the importance of this matter on every up-to-date farmer Especially is it important to young men who are beginning active farm life to put themselves in touch with the foremost men in the particular line of agricultural work they have chosen."

For myself, I confess I sometimes tire of trying to do for people who seem wholly indifferent to any aid or their own welfare. In this connection I recall a story of old General Nye, who said that if it was the Lord's will that there should be a church in North Pownall, Vermont, he saw no way but for the Almighty to accept such material as North Pownall had to offer. Let us hope that with returning prosperity, which especially to the cattle industry is now visible to the naked eye, our membership and the public interest in our work may greatly increase. It does not seem to me to be in the province of this address to discuss the various phases of the live stock situation. These will be considered in the addresses and discussions during the week. I will only call attention briefly to a few matters of general and vital interest. Never, perhaps, until the present season has it been conceded, all around, East and West, that Nebraska was the great feeding ground of the country. A recent report by an expert statistician, sent out from Chicago, says that our state is now fattening 2,500,000 cattle and 5,000,000 sheep, to say nothing of the magnificent herds of "mortgage lifters"—the swine. An enterprising and patriotic citizen feels a commendable pride that this state excels even in hoggishness—if they are all thoroughbreds, especially if they are of his chosen breed. So, while we all rejoice at every evidence of increasing business, we must admit that it is not positive proof of great profits; and profit is, after all, what most of us are in pursuit of.

FEEDING GRAIN.

I have noticed for years a disposition on the part of the agricultural press of the West to urge all farmers to feed out all the grain they raised, generally representing that by so doing they were sure to realize two or three times as much for their crop as they could by selling the grain. It has always seemed to me that these newspaper writers based their assumptions more upon theory than experience, and I believe many an intelligent and successful feeder will agree with me that for the last ten years at least the chances for profit and loss in feeding cattle and sheep have been about even.

But this idea, so persistently instilled into the minds of the small farmers, has only awaited conditions which made it possible to culminate in disappointment and more or less disaster. Two large corn crops in succession, with very low prices, coupled with an enormous accumulation in

Digitized by Google

the banks of money seeking safe investment, led to the purchase last fall of these millions of cattle and sheep, most of them of inferior or ordinary quality, by persons of little or no experience in feeding, at prices which few feeders of experience would pay, and which were out of all proportion to the price of fattened animals.

The "heads I win, tails you lose" process by which this has been brought about is as ingenious as a new-fangled rat trap; and the consequences to those who are caught are similar to those awaiting the rodents.

USURIOUS FEEDING SYSTEM.

Mr. Packer, or a syndicate of him, places an unlimited amount of money at the disposal of commission firms who can thus pay for feeders. They in turn sell to farmers on time, at from four to five cents per pound, the farmer giving his note at a high rate of interest secured by mortgage on the stock, also on all the feed on his farm, and signs a contract to finish them up in fine shape and return them to the same firm to sell back to the packer, who furnished the money at whatever he chooses to pay; and in order to make sure that the feeder shall not raise the money and pay his note and do as he chooses with the cattle, he is required to give a note in advance for the commission for selling, the commission man thus catching him a-going and a-coming, as the darkey did the coon. Already the results are beginning to appear, the packer is getting the cattle and 10 per cent on his money. The commission man has his two rake-offs, the farmer has got rid of his corn and hay and is lucky if the cattle bring enough to pay the notes and interest; but he had the fun of doing the business, and he also gets the experience. And yet the leading agricultural paper of the trans-Mississippi country editorially advises feeders to keep cool and stand by their feeding operations. It strikes me the advice is about as useful as if it had been perpetrated upon the fellow who had a bear by the tail and could not hang on and dare not let go. It would be an insult to the common sense of Nebraska farmers to presume that they will follow up that sort of a game very long.

SOURCE OF FEEDERS.

This brings us to the question of the future supply of stockers for our home farms and feed yards. In recent years a very large percentage of feeders have come from the ranges west and southwest of us, but the inclination on the part of the Texas cattle owner to keep, fatten, and market his own steers, coupled with the greatly diminished capacity of the western ranges for producing and carrying stock, renders it inevitable that the states of the central west, the corn states, must return to the production of more and better stock. This means the outlay of considerable sums for breeding purposes, but the increased profits of feeding better grades of cattle and the higher prices realized will more than make it up.

Adapting an idea from Mark Twain's new and deservedly popular book, "Following the Equator," to do this will be noble; but to show others how to do it is nobler and less trouble. It is a cause for congratulation that

Digitized by Google

competition has finally led the South Omaha Stock Yards company to reduce their charges along lines where attempted legislation had failed.

SUPPORT EXPOSITION.

We are constantly reminded by the press of the fact that the great Trans-Mississippi and International Exposition is soon to be held in our state, and the associations here jointly representing the great live stock interests of Nebraska should use every means in their power to insure a most creditable exhibition. I trust that during this convention those who are officially connected with the live stock departments of the exposition will have ample opportunity to inform us in regard to it.

I congratulate you that we are again permitted to spend a few days at this fountain-head of intellectual activity, and upon the program prepared for your instruction and entertainment. In succeeding sessions the various themes will be treated by men eminently qualified to instruct us, and whose presence renders any allusion of mine to those topics not only difficult but superfluous.

The recurrence of occasions like this seems to render it increasingly difficult to say appropriate things which you have not often heard before. There seems to be little opportunity for entire originality, but it is some consolation to know that even smart men, scholars and great orators, sometimes labor under the same difficulties. An eminent Boston lawyer whose charming home overlooks the historic old Lexington common, and whose tastes and opportunities for literary research are of the best, recently said in an address to the graduates of the high school of his native town: "I beg to remind you of a truth strikingly expressed by a poet and essayist who is nowadays, for some reason, little read, but whose delightful musings were widely enjoyed a generation ago. Mr. Alexander Smith says: 'What the world needs is not so much new thoughts, as that thought, when grown old and worn by usage, should, like current coin, be called in and reissued fresh and new.'" I have been obliged to abridge slightly the quotation in its application to myself, for his language is that the thought should, like current coin, be called in, and "from the mint of genius reissued fresh and new."

MODEST DISCLAIMER.

Considering the past experience, present condition, and the prospects of the live stock interests of our state, and their vital concern not only to ourselves, but indirectly to all classes of our people, I have sought to make such suggestions as seemed to me to be judicious and timely, and to present them, if not with grace, at least with earnestness becoming horny-handed sons of toil.

I fancy I hear you saying I have presented nothing which you had not known before. In reply I say I make no special pretentions to entire originality and only ask you to give my suggestions such consideration as they seem to you to deserve.

Mr. Rudyard Kipling, most original of modern poets—barring our own

Digitized by Google

and only Bixby—prefacing in rhyme a volume of his stirring ballads, ingeniously disarms criticism by penning these purposely ungrammatical and delightfully unique lines:

"When 'Omer smote his bloomin' lyre,
He'd 'eard men sing by land and sea,
And what 'e thought he might require
'E went and took—the same as me.

"The market-girls and fishermen,
The shepherds an' the sailors, too,
They 'eard old songs turn up again,
But kep' it quiet—same as you.

"They knew 'e stole, 'e knew they knowed,
They didn't tell, nor make a fuss,
But winked at 'Omer down the road,
An' 'e winked back—the same as us."

OUR TYPE.

BY C. H. SEARLE.

[A paper read before the Nebraska Swine Breeders' Association, Lincoln, January, 1898.]

I am wholly at sea as to what the "powers that be" intended me to write about: whether they wanted my type of a man, a Holstein cow, a St. Bernard dog, a Barred Plymoth Rock hen, or a Duroc Jersey hog. Man is an animal I never could understand, and I am not an admirer of any one type—I like a variety. And as for cattle, dogs, and chickens, they are all good, but a little "slow." I am bound to say that for a real genuine "Klondike" investment I still bank on the "strawberry blonde" or "gold standard" swine. So I have concluded, after weighing all sides of the question, to give you my idea of a Duroc Jersey hog.

It will not take me very long to tell you about this type, but I give you my word of honor that it takes a good while to breed them up as good as our judgment tells us they should be. When we get a herd as good as we once thought "standard" we find out standard has changed; so our type keeps just about so far in advance of what we are able to accomplish. Then again, when we have a certain type of ear, for instance, that we are working for, we are very liable to neglect some other important factor in the make up of the profitable hog, and before we know it we have, as a whole, an animal inferior to that with which we began. I mean by this to say that we ought not to get some particular hobby, like ear, feet, color, back, or hams, and turn our undivided attention to that part to the neglect of any other. All are essential, and lacking in any part the hog is incomplete.

Digitized by Google

We need to select our sires with great care in order to correct whatever defect we see in our sows. I think right here is where the average breeder of Duroc Jerseys fails. He seems to think if only a boar is of a suitable size, that is all that is required. But, granting that we have a good individual, a thing in which some are sadly deficient, we ought to have several, just as good as money will buy, from which to make our selections in mating. This is one of the very important things our best breeders are doing, which is being wholly neglected by the majority. And we cannot expect to get uniform advancement in the quality of the breed till this thing is done. Then again, we do not want to get it into our heads that our hogs are perfect. A man who thinks he has no faults, or rather who claims he has none, will bear watching. If he really has none, he will be wanted "up higher," and will not be apt to participate very long in the hog business. So the breeder who cannot see faults in his herd is not fit to be in the business. Only by keeping our standard in advance of any breeding will we be able to make any lasting improvement.

There is one very important point in which the red hogs need improving, and that is in their backs. We have succeeded in broadening them; but having such a long bodied hog there has been a tendency to sink or droop in the back. We cannot have a graceful or even a valuable hog unless we can keep his back up. We do not necessarily want to shorten them up, but we must, by judicious mating, get that back braced up so it will bear fattening, or loading down with pigs, and still be nicely arched. I think this has been neglected more than all other points of the hog. We have been working at color and one thing and another, but very few have gotten the back up where it ought to be.

I think I have said enough so that if you were to see "my type" you would recognize it at once. You would see, first of all, a Duroc Jersey. It would have a nice, thin ear, drooping at the tip; face slightly dished; nose rather sharp; back straight as to side lines, but arched a little; hams and shoulders full and deep, with hams rounding out; feet and legs short, and nicely tapering, but with lots of bone, especially on the farmer's hog; in color, as bright a "cherry" as I can get—a color which if once gotten will last as well as if dyed with Diamond dyes. The trouble with too many of the Durocs is that they are all right in color when pigs, but soon either fade out so they look badly, or get too dark, which is equally as bad. But there is such a thing as getting a color which will last, and that is what we want.

I referred a moment ago to the "farmer type." Let me explain. There is a great demand among farmers for boars to cross on their common sows, and I have had for years what I termed a "farmer's strain." It is coarser and longer bodied than the other type. These I breed for the farmer exclusively, as they will not make show hogs, that is, when young; but experience has shown that they do make the most improvement on common stock for practical results, and that is what the farmer wants. The other style of hog I breed for the thoroughbred business—more on the "show

Digitized by Google

type," as it is sometimes called. This type of a hog matures sooner, and will stand crowding from the time the sow is bred till the fairs begin. And right here let me say that that is the only way to make a successful show animal. I heard a breeder at the Minnesota State fair this fall apologizing for the appearance of a young boar. He said he did not begin feeding him for the fair quite soon enough. Of course there is such a thing as getting an animal over fat by fair time. But here is where judgment comes in, in knowing just how much to feed, and of what kinds of feed.

There is abundant room for both these types of hogs, and, although I shall expect to be criticised on this point, it will be mostly by Poland China men, and I shall disagree with them just the same. The fact is, our show type of Duroc Jerseys somewhat resembles Poland Chinas in form and general appearance. And that is all right, for we usually have Poland, China judges for passing on them. But they cannot make us believe that the ordinary hog as we find him cannot be benefited by the coarser hog with more constitution. If we have not a hog with more bone and constitution we have no better animal than the Poland. But we have that type of hog, both in style, constitution, and breeding qualities, and it would be utter folly for Duroc Jersey breeders to ape the Poland hog.

THE RED HOG UP-TO-DATE.

BY W. H. TAYLOR.

[A paper read before the Improved Stock and Swine Breeders' Association at Lincoln, January 18, 19, 20, 1898.]

Mr. President and Brother Breeders:

In looking over this program I find my name there for a paper, subject, the Red Hog Up-to-date. This is a subject that could have been presented by those far better qualified than I am, but I will try to give a little of the history of the red hog.

In searching for history on what is to-day called the Duroc Jersey hog we find they have had an existence for many years, but are as the Poland China—home-made. I can find nothing that shows them as an imported hog.

They first had a home in New Jersey and New York, resembling each other in general makeup and usefulness, but bearing a different name. New Jersey called them the Jersey Reds, which name has followed them all along the line by some breeders. They have been called Jersey Reds for over forty years, but have had an existence, running back into the past probably farther than any strain of hogs known to-day in America, excepting only the Berkshires, which is an imported hog.

Prior to the name given to them as Jersey Reds they were called red hogs. In New York they were called Durocs, deriving their name from a noted horse called Duroc.

In searching their history we find they have some characteristics that

Digitized by Google

have followed them all along the line for at least the past century. We find no place in their history where they have failed to give large litters and strong, well-developed pigs. And in the early history, as well as today, we find him second to no hog as a meat hog, always giving the best of results, being a growthy hog, and the meat of excellent quality. We have heard and read a great deal about that awful crime that was committed in 1873; just about this time the people, or at least some of them, felt that something must be done, and they organized the first standard of characteristics for the breeding of Jersey Red hogs. These characteristics were a red hog with a moderate length nose, large lop ears, small head in proportion to their size, long in the body, standing high and rangy on their legs, coarse hair inclined to bristles. At this time the red hog had pushed his way along to gain the position he occupied. McGee, of Ohio, had lived and acted, the result of which had placed a hog in the field that proved a winner, making a strong chasm for the red hog to cross and his advancing was slow, but we find he had a band of faithful and energetic admirers that clung to him, though the way looked dark. They worked upon the standard they had adopted, striving to improve on their hog, and succeeded to a certain extent, but the way seemed a hard one, and the progress was slow, but sure.

In 1881 or 2 the first association of record was organized, called the American Duroc Jersey Record. By this time the work of pushing what we (the admirers of the Duroc Jersey hog) think is the greatest hog known to the swine breeding industry, became a matter of great study to know just how to push him out and bring him to a level, at least, with his greatest competitor; but we find that his rival has been handled by good and competent men and has also been developed and improved, and stands as a mighty barrier in the way. Many breeders have thought at times that the time would never come when they would be able to take a place among the best, but with untiring nerve and strong determination they kept pushing; the results of their effort you have all seen in the red hog today. In discussing the merits of the red hog, I may say something about other breeds, but will say nothing with any disrespect to other hogs, for we, as breeders, have to acknowledge that we have four strains of hogs today that are all of them looking forward to a higher place, and, in fact, the first place, which is held to-day by the Poland China.

In looking over the history of the red hog we find he has had quite a little part in the make-up of the Poland China. In an early day of the Poland China, we find the work of the red hog cropping out; the strong blood that courses through his veins has been so strong that the sandy cast is seen even to-day. This I take to be one of the strong points in the red hog. A cross once made is lasting at least. While the red hog has changed quite a little we find he has held to many of the merits of usefulness. They are still second to none as producers, the large litters of old are still seen following them. Their record in the various stock yards of our land gives to them a place that is commendable, for they stand second to none.

Digitized by Google

They have gone into many tests as feeders which has been made for the purpose of showing to the world the adaptness of the hog, to make good use of the feed fed; you are all well acquainted with the results. Their quiet disposition makes them pleasant to handle and good mothers. The pigs, as a rule, are strong and vigorous. I have never known one to lay in the nest and thump his life out. They have been for the last fifty years called a great grass hog. This feature holds good with them to-day.

Their strong constitution makes them as safe a hog as any, at least when any of the hog plagues strike us. There are things we must guard against. We find the show ring has much to do with the kind of hogs we raise. Here, again, come in our rivals, and we are too apt to follow in their wake and pattern our hog after them, but this is going to be a mistake; we want quality and finish, but we must have a heavier bone and a more growthy hog.

If we must grow for the show yard, we should grow the two styles, for the show yard is leading us too fine. Let us keep our hog the nearest to the demands that are made that we can. The final end of the hog is the barrel, and the hog that can make us the most meat, quality considered and on the least feed, is the hog we want. I place the Duroc Jersey hog of to-day as that hog. Gentlemen, I thank you.

ALFALFA BY IRRIGATION.

By Mark M. Coad, Fremont.

[A paper read before the National Farmers' Congress.]

Mr. President and Gentlemen:

With your kind permission I will contribute to our honorable organization the result of my experience in the culture and uses of lucerne, commonly called alfalfa.

With land suitable for its culture, and a careful and intelligent preparation of the soil, alfalfa I have found to be one of the valuable crops. My experiments with the plant under irrigation have been made in Laramie county, Wyoming, at an elevation of 4,700 feet, and running through a period of seven years, that being a section where few if any crops can be surely and successfully grown without artificial irrigation.

The recital of my experience with the plant and any suggestions I may make with reference to its growth and utility, may not prove to be, invariably, the proper thing to do in every locality, as climate and soil are variable in different localities, and sound judgment and common sense must be exercised by the farmer in every instance that the best results may be obtained. What I have to say I hope will only be considered as simply stating my experience in my efforts to cultivate the plant and reduce its cultivation to a successful termination.

In commencing to establish a field of alfalfa the first thing to be considered is the selection and preparation of the soil.

Digitized by Google

Bench or second bottom land is better than bottom land, and sandy loam promotes its growth better than a clay subsoil. The most thorough preparation of the ground to receive the seed is necessary to obtain the best results, and for this purpose the plowing should be done with a subsoil plow and the ground carefully pulverized when not too wet, but in a friable condition. Where the field is sheltered from the high winds the best results will be obtained by plowing the ground in the fall. This, however, depends much upon the character of the soil. If the soil is very sandy, fall plowing will seriously injure it. If the subsoil has much clay in it, fall plowing is the best.

Before seeding in the spring the ground should be well irrigated, and as soon thereafter as possible, graded to an even surface to facilitate irrigation. A failure to grade the land to an even surface will double the labor of irrigating the tract.

The cost and trouble for preparing the field for easy and convenient irrigation are microscopical, as compared with the loss of labor and time required to properly irrigate a rough and broken surface two or three times each year for an indefinite period.

Before seeding, the ground should be thoroughly harrowed and if not sufficiently moist to cause the seed to germinate quickly, it should be irrigated until it is so, then sow your seed broadcast, putting from twenty to twenty-five pounds to the acre, and harrow twice lightly. Irrigation before sowing the seed promotes an equal growth of all the plants, which is much to be desired, as it results in producing a finer quality of hay and prevents an uneven growth of the plant where some of the stocks are overgrown, bushy and woody, and others are smothered by their more thrifty neighbors.

Where the plants stand sparsely on the ground they will be of little value as compared with those that come up evenly and cover the ground closely.

If the ground is very light and porous at seeding it is better to roll it one time, otherwise I have found the rolling immaterial.

If the ground is well irrigated before seeding it will contain sufficient moisture to insure growth of the plants until they become sufficiently large and strong to withstand renewed irrigation; otherwise they may perish for the want of moisture or be destroyed by an attempt to irrigate the crop too soon after its germination.

The most delicate and dangerous condition of the life of the plant is the first month after it begins to appear above the ground. Irrigation during this time is liable to prove very injurious to the crop.

By irrigating before seeding the plants will grow sufficiently large before they need more water, so they may be safely watered.

The best time to seed in our locality is from the 10th to the 15th of May; it should not be sown in any locality until all danger from hard frost is past. If properly seeded, and alone, which manner of seeding I prefer, it ought to make from one to two tons of hay the first year and from four to five tons each year thereafter. Many farmers prefer the press drill for

Digitized by Google

seeding purposes. I do not, but if the drill is used, much care must be exercised to prevent planting the corn too deep, as too deep seeding would be as likely to prove a failure as too shallow; from two to three inches is as deep as the seed should be deposited. After the plants are well set, an irrigation after each sowing is usually sufficient water to insure another crop.

Great care should be taken in the selection of the seed to see that it is plump and free from shriveled and faulty grains and absolutely clean and free from all other plant seed. Great injury has resulted in many instances by a failure to properly observe this last suggestion.

The making of a choice quality of alfalfa hay is attended with much care and requires favorable care and much skill and experience. It should be cut as soon as it begins to blossom.

The hay should be sufficiently cured to prevent its moulding in the stack, and not cured so dry as to cause it to lose its leaves, which we think the most nutritious part of the plant. Great care must be taken to prevent either of these conditions.

The general method is to rake the plant when cut and still green into wind rows and let it so remain until quite cured and then pile it with forks into small shocks where it is allowed to stand until ready for stacking when it is carefully handled, hauled, and stacked. This process makes beautiful hay, provided always it is not rained upon before you get it in the stack, but it is a slow process, and where a large acreage is to be harvested it is too expensive.

Alfalfa can be cured with good success by competent men in the windrow. It is, however, important when cured in this way that ample facilities be furnished for stacking it rapidly; otherwise it will be much damaged in stacking.

I find alfalfa good feed at all seasons of the year, and for all kinds of live stock, including chickens and hogs. I can raise hogs more cheaply upon it than any other crop, and when about ten months old, they only required to be fed about six weeks on grain to make excellent pork.

If the plant is grown for seed it requires very little water. Many experiments have come under my observation where, for seed purposes, the best results were obtained where no irrigation was used.

It is undoubtedly the best and most valuable grass grown in our section of the country.

HEN FRUIT.

By J. T. Swan, Nemaha County.

Few realize the all important care of eggs. In the first place laziness, recklessness, carelessness, and negligence are the main cause for all failures in a small business or large, whether it be agriculture, horticulture, mercantile and manufacturing, or any other vocation for realizing the all importance of time. Would you think of going to meet a train five min-

Digitized by Google

utes after schedule time? if you did you know the consequences. You mus in all transactions create a desire to be always prompt in all your business transactions to all of your daily labors; have a system and cultivate beyond every other thing the one thing and the one only that is sure to bring success to each and every one in following out these rules in all cases. Always run your business, and in no case, and under no circumstances, allow your business to run you; if you do you will certainly fail. It makes no difference what vocation you follow, never make a promise you cannot fulfill; make your word your guidance, and so every one will say, "If he said so, that is enough." But how few realize that lagging behind not only costs time to him but sometimes robs a score of others of valuable time by his being behind. Work your business, whatever it be, is the best system, and when once in the right channel do not change it, as all business success or failure depends on promptness and system. "Well," you may ask, "what has this all got to do with eggs?" It has everything to do. Have a time to gather your eggs, say once a day; never allow them to be gathered less than once a day as twice is better. You cannot keep your eggs too fresh. Few realize or ever stop to think how many days, and sometimes weeks, it takes in marketing this product. Some will ask the question, why eggs are worth here in July and August four to five cents and same are selling in Connecticut for thirty cents a dozen. Something must be wrong. Did you ever think, farmers and producers of this dainty morsel of food, that it needs almost as tender care to keep its quality, as does your meat on a hot summer day. One hour extreme hot sun will almost ruin an egg for immediate use, let alone having to be held for two weeks for market.

Now you gather your eggs and keep them at home from one to seven days, as Saturday seems to be the day for general marketing among farmers, as we get nearly as many eggs in store Saturday as all the rest of the week. Now, suppose you keep them at home this time, we invariably do not allow them to remain in our store over three days at outside, realizing the loss is not only ours but is yours as well. As it is to our interest to pay you big prices as well as your own, as the more money you get for your eggs the more goods it enables you to buy, and we are the gainers as well as you, then say you keep your eggs four or five days and we keep them three. Now they go to the egg market in our city and there remain at best one or two days, then in transit to eastern market two or three days at best, then to be reshipped from, say New York, to some city in Connecticut two or three days more are used up as you readily see by this transporting; it is an awful journey for a healthy egg to undertake, let alone a sick one. As you all know, it will kill a sick person to make such a trip, so will it an egg.

Consequently our eggs we are forced to sell cheap and they are consumed near home.

Now, this gathering and keeping your eggs and marketing at your earliest convenience is your profit and loss, as the case may be. Do not forget that the carelessness of marketing eggs is any one's fault but your own. Gather your eggs and market if possible every day; if not, never

Digitized by Google

later than twice or three times a week. I will guarantee that I can tell nine times out of ten the kind of a housekeeper your wife is by looking at the eggs she brings to market.

Now, you would not think of bringing a roll of butter to market all covered with mud, but don't you bring your eggs tha tway. Oh, I have often thought on looking at and handling these goods of the amount of labor that is thrown away by carelessness from the beginning. Your carting to market, our handling, the egg house handling, and throwing away barrels of spoiled eggs, and then being re-handled a second time. All this work and labor for nothing. But, says some, "this is a small item, fooling with eggs"; now, right here I want to say, for the benefit of a few farmers, it is the little things that keep the expenses up on your farm. It is the little breaks that sink the greatest ships. Now you have heard the remark, "that a man who can do nothing else can make a living farming." I want to say to you right now, there are more failures among the farmers than in any other business. Now I want to say to you, that there are more farmers starving on farms than there are that are making a decent living on them, let alone making a success. I tell you it takes just as much financiering to make a farm pay and make it a success as it does to run a mercantile or any other business.

Oh, how few realize the amount of money that is spent yearly for these little white houses containing the finest meat our country can grow. It is sought for in the lowly thatched cottage, from there to the costliest mansions in our land.

What is there that helps the appearance of a farm more than to have your buildings painted white as snow; now think of this dainty little white house full of meat that the allwise creator has caused to be placed around this precious morsel. Then how can you allow it to be disrobed of its loveliness. Take care then and do not allow your eggs to become dirty. Keep in a dry, cool place and never allow them to get wet, or it will cause decay the same as with all meat, vegetables, and fruits; they grow and grow until they are ripened, and the moment they are ripe they begin to decay. So it is with the egg; it cannot be handled too carefully.

Now about the consumption of this one article. I am unable to give any figures, and there is no way of getting at this as there are so many being consumed at home that only a partial estimate can be derived; but the egg product runs up into millions of dollars yearly. As the consumption of meat, it is only exceeded by beef and pork and some go far enough to say that it exceeds either of these in pounds. Now, I might add page after page to this, but you will go on just the same and let the eggs rot, and who is to blame?

Digitized by Google

THE WHEAT CROP OF THE WORLD.

PRODUCT OF 1897 COMPARED WITH TWO YEARS PRECEDING.

The following are estimates of the wheat crop of European countries for the years 1895, 1896, and 1897. The figures are given in quarters, a grain measure equaling eight bushels.

	1897. QRS.	1896. QRS.	1895. QRS.
Austria	4,250,000	4,750,000	5,050,000
Hungary	13,500,000	17,500,000	19,050,000
Belgium	2,500,000	2,500,000	2,300,000
Bulgaria	4,000,000	6,250,000	5,750,000
Denmark	500,000	500,000	550,000
France	36,000,000	43,000,000	42,300,000
Germany	12,500,000	13,000,000	12,800,000
Greece	750,000	750,000	750,000
Holland	750,000	750,000	650,000
Italy	12,500,000	16,500,000	14,000,000
Portugal	600,000	500,000	700,000
Roumania	6,000,000	8,625,000	8,250,000
Russia	37,000,000	43,500,000	41,700,000
Caucasus	6,000,000	5,500,000	8,000,000
Servia	1,250,000	1,750,000	1,250,000
Spain	12,000,000	11,000,000	13,000,000
Sweden	500,000	500,000	550,000
Switzerland	500,000	600,000	600,000
Turkey Europe	3,750,000	5,000,000	4,500,000
United Kingdom	7,000,000	7,250,000	4,750,000
Total Europe	161,850,000	189,725,000	186,550,000
Equal bushels	1,294,800,000	1,517,800,000	1,492,400,000

It will be seen that, with the exception of Belgium, Greece, and Holland, the above figures indicate deficiencies for 1897, as against the product of one or both of the preceding years, amounting, in the case of Italy, Turkey, and Roumania, to between 25 and 30 per cent, while in Hungary the decline, as compared with 1895, is over 20 per cent. The result as to Russia is all the more noticeable in view of the fact that the estimates for that country include Siberia, a vast wheat growing region, where the product has been rapidly increasing in recent years. The deficiency for Russia, as compared with the crops of 1896, amounts to 15 per cent, while that of France, next to Russia the largest wheat producing country of Europe, is still more.

The falling off in 1897, in bushels, as compared with 1896, is 223,000,000 bushels. Thus is created a great deficiency in those countries, while the crop in British India is also far below the average annual product. The crop of the United States, on the contrary, is estimated to be at least 40,000,000 bushels greater than in 1896, the most careful statisticians having placed it at 465,000,000 bushels. Allowing 200,000,000 bushels for home

Digitized by Google

consumption (which is above the ordinary figure), it will be seen that the United States' surplus for exportation in 1897 was 265,000,000 bushels exclusive of the quantity of last year's crop in the hands of farmers in the spring of the year under consideration. This reserve supply has averaged annually since 1880 more than 100,000,000 bushels. Estimated at that, the number of bushels available for export was 365,000,000.

[From this it will be seen that the future for the wheat crop factor in the United States is encouraging —ED.]

REMEDY FOR HOG CHOLERA AND SWINE PLAGUE.

Dr. Salmon, Chief of the Bureau of Animal Industry, United States Department of Agriculture, says that for a long time after beginning the investigation of infectious diseases of swine, he was doubtful whether any remedy or combination of remedies could be made which would produce any marked effects. Experiments indicated, however, that treatment, if properly applied, may be successful. Dr. Salmon, with the assistance of Dr. E. A. De Scheveinitz, chemist of the bureau, and Dr. A. V. Norgaard, inspector, developed a number of formulas and used them in the field with good results. The most efficacious one tried is the following:

	POUNDS.
Wood charcoal	1
Sulphur	1
Sodium chloride	2
Sodium bicarbonate	2
Sodium hyposulphite	2
Sodium sulphate	1
Antimony sulphide (black antimony)	1

These ingredients should be completely pulverized and thoroughly mixed.

The dose of this mixture is a large tablespoonful for each 200 pounds weight of hogs to be treated, and it should be given only once a day. When hogs are affected with these diseases they should not be fed on corn alone, but they should have at least once a day soft feed, made by mixing bran and middlings, or middlings and corn meal, or ground oats and corn, or crushed wheat with hot water, and then stirring into this the proper quantity of the medicine. Hogs are fond of this mixture, it increases their appetite, and when they once taste of food with which it has been mixed they will eat it though nothing else would tempt them.

[The compiler of this volume has used the above formula with better success than all other remedies of which he has had knowledge and use.—ED.]

PLANTING IRISH POTATOES.

To settle the question whether better results are secured by planting large, instead of small seed pieces, Agricultural Experiment Stations have

Digitized by Google

made many tests, with summary of results reached as shown by the following table:

AVERAGE DIFFERENCES PER ACRE IN TOTAL YIELDS FROM DIFFERENT SEED PIECES.

	BUSHELS.	PER CENT.
Excess from use of—		
2-eye pieces over 1-eye pieces	26	21
Quarters over 2-eye pieces	15	16
Halves over quarters	24	18
Whole tubers over halves	31	18

AVERAGE DIFFERENCES PER ACRE IN GROSS SALABLE YIELDS FROM DIFFERENT SEED PIECES.

	BUSHELS.	PER CENT.
Excess from use of—		
2-eye pieces over 1-eye pieces	23	21
Quarters over 2-eye pieces	10	15
Halves over quarters	15	15
Whole tubers over halves	14	10

AVERAGE DIFFERENCES PER ACRE IN NET SALABLE YIELDS FROM DIFFERENT SEED PIECES.

	BUSHELS.	PER CENT.
Excess from use of—		
2-eye pieces over 1-eye pieces	15.0	14
Quarters over 2-eye pieces	7.0	15
Halves over quarters	5.0	6
Halves over whole tubers	8.5	8

It will be noted that every increase in the size of the seed-piece was followed by an increase in the yield per acre (table I.); by an increase gross yield of salable potates (table II.); and the amount of the net salable crop also rose with the increase in the size of the cutting (table III.); and when the whole potato was planted the figures declined on account of the large amount of seed potatoes which had to be deducted. The above figures indicate a very slight advantage in planting halves rather than quarters when the price of seed and of crop produced are the same. As a matter of fact, spring prices are usually somewhat higher than fall prices. A high price for seed potatoes may make it profitable to plant smaller pieces (as, for example, quarters) than would be economical where seed and crop command the same price per bushel.

Digitized by Google

AMMONIA CHEAPER THAN SOAP.

Ammonia is cheaper than soap and cleans everything it touches. A few drops in a kettle that is hard to clean makes grease and stickiness fade away, and robs the work of all its terror. Let it stand ten minutes before attempting to scrape off, and every corner will be clean. It cleans the sink and penetrates into the drain-pipe. Spots, finger-marks on paint disappear under its magical influence, and it is equally effective on floor and oil cloth, though it must be used with care on the latter or it will injure the polish. There is nothing to equal it in cleaning the silverware, and it gives a higher polish and keeps clean longer than anything else. If the silver be only slightly tarnished, put two tablespoonsful of ammonia into a quart of hot water, brush the tarnished articles with it and dry with a chamois. If badly discolored, they may need a little whiting previous to the washing. An old nail brush goes into the cracks to polish and brighten. For fine muslin and delicate lace it is invaluable, as it cleans without rubbing the finest fabrics. Put a few drops into your sponge bath in hot weather, and you will be astonished at the result, as it imparts coolness to the skin. Use it to clean hair brushes, and to wash any hair or feathers to be used for beds or pillows. When employed in anything that is not especially soiled, use the waste water afterward for the house plants that are taken down from their usual position and immersed in the tub of water. Ammonia is a fertilizer, and helps to keep healthy the plants it nourishes. In every way, in fact, ammonia is the housekeeper's friend."

HOW GRAIN WILL SHRINK.

Farmers rarely gain by holding on to their grain after it is fit for market, when the shrinkage is taken into account. Wheat, from the time it is threshed, will shrink two quarts to the bushel, or 6 per cent in six months, in the most favorable circumstances. Hence, it follows that ninety-four cents a bushel for wheat, when first threshed in August, is as good, taking into account the shrinkage alone, as $1 in the following February.

Corn shrinks much more from the time it is first husked. One hundred bushels of ears, as they come from the field in November, will be reduced to not far from eighty. So that forty cents a bushel for corn in the ear, as it comes from the field, is as good as fifty in March, shrinkage only being taken into account.

In the case of potatoes—taking those that rot and are otherwise lost, together with the shrinkage—there is but little doubt that between October and June the loss to the owner who holds them is not less than 33 per cent.

This estimate is taken on the basis of interest at 7 per cent and takes no account of loss by vermin.

Digitized by Google

HOW TO EBONIZE BOTH HARD AND SOFT WOOD.

Make a strong decoction of logwood from the ground wood, not the extract; wash over the article, using it hot, until satisfied that the wood has been fully penetrated (the harder the wood the more washing required); when dry, or partly so, wash with a solution of acetate of iron, and it changes quickly to a jet and permanent black. Make the iron solution by putting a few clean nails or iron filings in strong vinegar in an open vessel to permit the escape of gas, letting it stand a week before needed for use. This method gives a stained surface, which, as it can be made to penetrate the wood, will admit of rubbing down, polishing, etc.

NEW TANNING MATERIAL.

A citizen of Vermont has made a discovery in tanning leather, which he claims will revolutionize the business. The material he uses is dye from forest leaves. He has been experimenting with leaves for the past two months, and the result is said to be entirely satisfactory. One ton of leaves will tan as much leather as five cords of hemlock bark, and will do the work in one-half the time. By mixing the leaves and bark in equal proportions, one-fourth of the time is saved. The leather tanned by the process is smoother and more flexible, and yet retains the strength of the raw hide in a greater degree than that tanned by bark.

THE UP-TO-DATE HORSE AND THE EXPORT DEMAND.

[As of interest and value in connection with this volume, the compiler uses a paper read by F. J. Berry before the Illinois Farmers' Institute. Subject, "The Horse in Demand." Mr. Berry is one of the very best posted horsemen in the United States.]

My endeavor will be to show the kind of a horse that the market demands at present and the most salable kind of a horse for the export trade. Every horse should be bred for a purpose, and to meet all the requirements of his class, *i.e.*, with all the qualities that are required of his class at the present time.

There are five distinct classes of horses, and every horse for the market must fill all the requirements of one of these classes or he is condemned as a no-class horse, and is of but very little value, and would not sell in our markets to-day for anything like the expense of producing him. Therefore he would be considered a failure; at the same time he might be a very useful animal in the country, while he would not sell in our markets for more than a fraction of what he cost to produce. Small, rough, and ordinary horses are a thing of the past, and never will be of any considerable value again.

The export demand is divided into five different classes, of which I will give an accurate description later on. Every horse must be an animal

Digitized by Google

distinctly of his class, and the grades that are the most salable and profitable horses to produce for all export markets are the very same kinds that are the most salable in all American markets. Therefore, a man in breeding horses for the export demand can make no mistake, as the very same kinds that meet that requirement are the ones that are the most salable and profitable in America. The up-to-date horse of to-day is a very much different animal than he was five years ago, and one consequence of this is that the breeder of horses is not left to his own resources, as he has been in former times, but has a fixed type before him demanded by the market. And to meet the American, as well as the export demand, he has to breed strictly to a purpose, for every horse must be one of the five different classes.

In former times there were no classes of market horses. Every farmer could breed to his own fancy, and usually bred the kinds of horses he might have, regardless of what he might produce; and as every man had different ideas, all kinds of horses were bred and raised. In this way a large per cent of the stock produced was too small and inferior and low grade to ever make marketable and salable horses.

Before 1887, there never was a regular market established in this country where a man could ship a load of horses and close them out immediately, neither were there any fixed market values until that time. It was just as men could agree as to prices, and there were as many different ideas about the values of horses as there were different horses. Therefore, every man bred and raised horses according to his best judgment and sold them whenever he could. Or, he would bring them to market, and they would sometimes stay at boarding stables until they nearly ate up their value in many cases, and for the larger part of them he would finally find a customer to whom he could sell them at some price; but very often he would ship them back home, thus finding horse raising very unsatisfactory and unprofitable business, although horses were high-priced at that time. But about 1887, a market was established at the Union Stock Yards, Chicago, where all horses were sold readily at market prices. This market increased and grew stronger, until now it is the largest horse market in the world; and a man can now ship a carload of horses and sell them as readily as cattle.

Prices remained high all the time until the panic of 1893, when all branches of business were depressed. Prices then became very unsatisfactory, and all kinds of properties sold low, especially the horse. It has been said that there was an overproduction of horses previous to the year 1893, and we presume there was of the class that was produced, but at the same time there were not too many good horses produced. Had the times remained good, they all would have been taken at firm prices, but while the supply was on hand the demand decreased, and it left an oversupply of horses, the most of which were very unsaleable, being inferior and small.

During the depression, from 1893 to 1897, many changes went on, and

Digitized by Google

under them the whole horse problem was revolutionized. While the "wheel" came in, and, it has been said, took the place of the horse, we doubt very much if the "wheel" has decreased the value of the horse either in price or in numbers demanded. While it has in a small measure taken the slace of the small horse, it has made a demand for a larger and finer animal, for as the interests brought about by the "wheel" have improved streets and roads, this has been the means of increasing the demand for a larger and finer horse. We very much doubt if the "wheel" has depreciated the value of the horse either for use or for sale.

It is believed by some that electricity will take the place of horses. We believe it never will. It is not practicable. We believe this is an erroneous idea. Horses have been beasts of burden and pleasure ever since civilization began, and we believe they will remain so. While electricity has taken the place of the street car horses, there are many other uses that will make a demand for the horse in this period. Electricity has extended the street car lines far into the suburbs, thus causing people to live farther from the center of the city, where they can secure cheaper homes, and many of them keep horses of their own who never kept them before. And as all goods are delivered from the center of the city to the suburbs, where one horse was used for delivery wagons three years ago there are five used at the present time, thus making a large increase in the demand in this direction.

In the meantime the export demand, which commenced in the year 1893, has developed. It doubled in 1894, doubled again in 1895, and 35,000 horses were exported in 1896. Fifty thousand horses were exported in 1897. Thus, while the demand has decreased for one purpose, it has increased for many other purposes, making a larger demand to-day than ever before. And as the number of colts raised since 1893 has been a mere nothing, our visible supply of American horses is reduced about three millions. We are not only reduced in numbers, but by a much larger per cent in quality. Good horses have become very scarce, and there will be a great shortage of the best kinds of horses in a very few years. Now the great depression has all passed away; times are better, business is good; there is a stronger demand for all grades of horses, while our very choicest specimens of light harness and coach and heavy draft horses are worth nearly double to-day what they were two years ago. The medium classes have advanced considerably, while the lower grades still remain low.

Now, I will give a description of the five different classes covering the export as well as the domestic demand.

Class No. 1. Drivers and Coachers. These must be of good color, well bred. Wilkes preferred, from 15.3 to 16½ hands high, with fine heads and necks, plenty of bone and substance, short back, smooth hip, round barrel; must be good travelers, and if they have some speed all the better. The requisite qualities are style and action, the latter being the most important. This class has advanced very much in price, and are worth nearly double the figures they sold at two years ago, the range in price being from

Digitized by Google

$100 to $300. Some very rare specimens of this class sold at auction in the Chicago market the first week of January, 1898, as high as $450.

In case of a lack of Hambletonian stallions of size to produce this class, the French coach horse has been crossed with trotting bred mares with extremely favorable results, and it is the opinion of the best breeders and horsemen that we will have to cross our good trotting bred mares with the French coach horse in order to produce the light harness horse large enough and of combined qualities to meet the coach horse demand. It is believed that this cross of breeding will produce a fixed type of a coach horse that shall not only possess all size and quality, action and style, but will also still retain the road qualities required, as every light harness horse should be well bred in order to stand the wear and tear and hard work of pavements and the long drives of city service, and the more he partakes of the blood of the trotter the better.

Class No. 2. A Cab Horse; rather blocky build; weighing 1,100 pounds and standing 15¼ to 15½ hands high, smooth made with bone and substance, fair traveler; price about $75. This class of horse is a very salable kind for many purposes, but they are always plenty on our market, too plenty to be profitable horses to raise. At the same time, in breeding horses the breeder will always get some of this class; and will find a fair demand for all, although the price will never be high. This is the smallest class that ever should be bred, as there is no demand for anything smaller except at ruinous prices.

Class No. 3. A 'Bus Horse; a blocky smooth made horse that must shape himself well in harness, standing 15¼ to 16 hands, plenty of bone and substance, fair traveler and fair action, weighing from 1,250 to 1,400 pounds. This class of horse includes the quality not only of an omnibus horse, but of an express and general purpose horse. The English use the blocky lower set ones for bussers, while the larger ones are used for express and general purposes. This class of horse is in the strongest demand in all American and foreign markets, and sells at from $80 to $125, and can be produced best by the Percheron horse crossed with a smaller mare that has some breeding and good style and action and road qualities.

Class No. 4. The Draft Horse; should weigh from 1,500 to 1,800 pounds, blocky made, heavy boned, with smooth finish, good quality and action, and a first class draft horse in every respect; present price from $100 to $250, the best specimens selling as high as $300. This class is one of the most salable and will find ready sale in all domestic and foreign markets, and can be produced from the best heavy draft mare of good quality crossed with the best heavy draft horse of high quality, regardless of what breeding of a draft horse he may be, as long as he possesses all the qualities of a draft horse.

Fifth and lastly: "The American Trotter," which in all cases must be a high bred trotting horse with good bone and substance, high finish, good action and disposition; and the more speed he has the higher price he will bring, ranging from $200 to $5,000, according to his quality, size, and speed.

Digitized by Google

All horses for export must be perfectly sound and without blemish, and are bringing at present a higher range of prices than horses sold for any other market.

Good horses will become higher and higher priced for many years to come, as there is an increasing demand and as most all Europe have turned their attention to our American horses, which are giving entire satisfaction. It seems to be the general impression that all countries in Europe will want American horses for many years. Breeding is reported to have ceased there, as they can buy American horses much cheaper than they raise them on their thickly populated and high-priced land. We believe there will be no let-up to the export demand and that it will increase all the time, for nothing can ever stop that demand, unless it should be extreme high prices and the scarcity of good horses.

The greatest need of the present day is a fixed type of coach horse or light harness horse, and we believe that the best blood to produce them is from the American trotter. We also believe that if the same care is taken to produce size, shape, and quality that there has been to produce the American trotter with extreme speed, a still higher class of horse can be produced from the blood of the trotter by combining size and qualities with his road qualities. And in case of a shortage of Hambletonian stallions of size to produce this class, we would heartily recommend, to bridge over the present emergency, the French coach horse for the first cross, until you get the size and quality, and then breed back to the American trotter. The American trotter is the highest class horse the world has ever produced. He has been evolved within this century, and we have every reason to be proud of him, as he is purely an American product and has made a world-wide reputation.

It should be our main aim now to produce a fixed type of coach horse, and when this is accomplished we shall have the most profitable and most salable horse the world has ever produced.

EXPERIMENTS WITH FORAGE CROPS.

By Prof. T. L. Lyon, U. S. Experiment Station of Nebraska.

It has become necessary to find some substitute for the ordinary native or tame grass pastures during the late summer. In this region these pastures dry up at that time of year to such an extent as to afford no succulent food whatever. To the dairyman this is a very great source of loss, owing to the consequent diminution in the milk flow of the cows at pasture. Such loss, when computed for the entire state, is enormous. This fact is so patent to dairymen that it requires no further elaboration.

Fortunately, there are certain plants adapted to summer feeding that retain their succulence throughout the entire summer. With the exception of alfalfa, however, these are uniformly annuals. It thus becomes necessary to sow for forage every year.

Digitized by Google

In the summer feeding of dairy stock any one of three systems may be followed. The cattle may be permitted to feed on permanent pasture, they may be fed in barn or feed lot with green forage brought from the field every day—which method is termed soiling—or they may be pastured on land planted to forage crops. Manifestly where land is abundant, and where perennial grasses grow luxuriantly throughout the entire summer, permanent pasture is vastly preferable to either of the other two systems. It has, however, been largely abandoned in some of the European countries, the high price of land making it unprofitable. We find, for instance, that Germany has 10,000,000 cows and 14,000,000 acres of pasture, while the island of Jersey has 7,000 cows and 14,000 acres of pasture.

Of the three systems of feeding mentioned, permanent pasture has the great advantage of requiring comparatively little labor in the production of feed, but it generally has, in this country, and especially in the West, the decided disadvantage of failing to furnish an adequate supply.

Soiling requires more labor than either of the other methods. Feed must be cut, hauled, and fed, so that the expense about equals that of winter feeding as far as the item of labor is concerned. Furthermore, the work comes at a time of year when farming operations are most active. It presents, therefore, manifest disadvantages in a country where land is plenty and labor expensive. Its advantages over permanent pasture are that less land is required to maintain a given number of animals, and there is no waste of energy with consequent loss of milk production occasioned by a search for food. It is fair to say that an acre of land will produce from two to three times as much milk or butter when planted to soiling crops as when pastured.

It seems possible to follow a system of summer feeding that will possess certain advantages over both permanent pasture and soiling. This consists in planting annual plants that will serve as forage crops, and, when they have attained a proper growth, allowing the cattle to pasture on them. This system may be used to supplement permanent pasture when it fails, or to replace it altogether. It insures succulent fodder during the entire summer, and does not entail the expense of cutting and feeding the crop. It does, however, necessitate preparing the land for each crop, and increases to some extent the amount of fencing required. It also has one disadvantage that soiling does not possess, in that a portion of the crop is destroyed by the tramping of the cattle, but this is much less than one would imagine.

In order to ascertain the amount of land required to support a cow during the summer, and thus to estimate the cost of feeding in this way, a cow was pastured through the summer on measured plats of land planted to rye, as representing early forage, and sorghum as representing a late one. The plats, when pastured, were fenced off by a temporary fence and the animal kept in this enclosure during such a period as the crop afforded sufficient pasture. A two year old heifer, weighing about 800 pounds, that was not giving milk, was used for the experiment. She was weighed each time she was put on a plat, and when she was taken off.

Digitized by Google

A plat was drilled to winter rye on April 27; the heifer was put on June 17. It afforded pasture at the rate of one acre for one cow one hundred and nine days.

Early amber sorghum was sown broadcast on June 29, and this was divided into plats and pastured off in order to determine at what period of its growth it afforded the most forage. Began to pasture August 4. Calculating the pasture afforded one cow by an acre, it was found that when two and one-half feet high there was pasture for ninety days; when three and a half feet high, for one hundred and nine days; when four and one-half feet high, for one hundred and twenty-seven days; and when five feet high, for the same length of time. It had now headed out, after which it did not furnish as good forage, as shown by the fact that it afforded pasture for only ninety-nine days in one case, and later only seventy-two days. It will be noticed, on the one hand, that before this period it afforded more forage as it grew higher. There were more stalks left in the field when higher, but this was more than compensated for by the greater weight of leaves and succulent stalks. These results point to the conclusion that the most profitable time to pasture sorghum is when it has attained full height, but before the heads have begun to form.

On October 15 the heifer was placed on a plat, off which she had been taken two months before. This was now covered by a regrowth two and one-half feet high. The second growth, however, was more luxuriant than was the first growth, and although it was only two and one-half feet high, it furnished feed at the rate of one acre for one cow one hundred and thirty-six days. This was in spite of the fact that the leaves were quite badly frosted.*

The following table shows the length of time that pasture was afforded by certain crops at different periods of growth:

Crop.	Height.	Pasture Afforded by one Acre.
	Feet.	*Days.*
Rye (winter rye sown in spring)	.....	129
Sorghum	2½	90
Sorghum	3½	109
Sorghum	4½	127
Sorghum	5	127
Sorghum, heads formed	.....	99
Sorghum, seeds ripe	.....	72
Sorghum, second growth	.....	136

A large number of forage crops were grown in one-tenth acre plats of land in order to compare the rate of yield of green fodder. Many of these did not prove to be well adapted to Nebraska, and some contained so much

* This does not mean that the pasture would actually last for this length of time, but merely at this rate. It would perhaps be more accurately stated by saying that one acre would furnish pasture for ten cows for one-tenth of the periods indicated.

Digitized by Google

woody material as to make them unfit for forage; notably Sacaline and the Florida Beggar Weed.

The crops which proved themselves capable of making a healthy growth in this climate and soil, and at the same time proved to possess at least some value as forage, gave the following yields:

	Pounds per acre.
Sorghum	34,181
Red Kafir corn	24,060
White Kafir corn	32,020
Canada field peas	7,650
Hairy Vetch (*Vicia villosa*)	13,000
Burnet	10,300
Jerusalem corn	20,700
Milo Maize	21,200
Soy beans	15,000
Cow peas	22,850

This table does not indicate the relative value of these crops as forage, either as to the amount of nutriment furnished or their effect upon the milk flow, but it will serve as a means of comparing their value as forage crops on the basis of yield.

The following table is an attempt to show the actual number of pounds of food ingredients raised on an acre planted to certain of these forage crops.

	DRY MATTER.	PROTEIN.	FAT.	NITROGEN FREE EXTRACT.	FIBRE.
Sorghum	6152	889	273	2700	1846
Red Kaffir corn	5750	669	142	2815	1747
White Kaffir corn	7653	910	189	3746	2325
Canada field peas	1121	310	57	410	236
Hairy Vetch	4069	671	165	1914	1005
Soy beans	3780	525	150	1725	1095
Cow peas	3770	708	137	1650	799

It may be well to explain briefly the significance of the terms used to designate the groups of substances that go to constitute a fodder.

Dry matter is used to designate the whole amount of material remaining in a fodder when all of the water has been removed. It is composed of the substances given in the four right-hand columns, and also of the ash, or mineral matter of the plant. The dry matter of a green plant forms but a small part of it, most of the plant being water. This water doubtless has no greater feeding value than has that drunk by the animal, so that we look to the total amount of dry matter to indicate the true yield of a forage crop.

Protein (or nitrogenous materials) constitutes the flesh-forming material in the food. It furnishes the substance for the lean meat, blood

Digitized by Google

skin, muscles, tendons, nerves, hair, horn, wool, the casein, and albumen of milk, etc. In addition to this it forms fat in the body and in milk, and may be burned in the body, furnishing heat and energy. Protein is the only ingredient in food that can build up flesh in the animal body, or that can produce the flesh destroyed by muscular exertion or the casein removed by milk production. The great importance of this constituent may thus readily be seen. Foods rich in protein occupy the same place in the feeding ration for stock as do meat and eggs in the human diet. Unfortunately much green forage and other fodder is deficient in protein, so that in judging of the relative merits of different food stuffs, any food containing a large proportion of this substance should have a high value placed upon it, especially for milk production.

Fat in food is much the same substance that is found in butter, tallow, lard, etc. It contains, in addition to pure fat, some wax and coloring matters, so that a statement of the amount of fat in a fodder represents something more than the actual amount of the pure article present. The fat of food is either stored up in the body as fat, or burned to furnish heat and energy.

Nitrogen Free Extract is a term used to designate certain constituents of foods that do not contain nitrogen. Starch, sugar, and gums form a large portion of this class of compounds in most fodders. They also constitute a larger part of the dry matter of these fodders than does any one set of substances, and may be considered as ranking next in feeding value to the two preceding classes, protein and fat. They are quite easily digested by the animal. When taken into the system they are either stored up as fat or burned to produce heat and energy.

Fibre is the woody portion of the plant. It has about the same chemical composition as does the nitrogen free extract, but is not nearly so digestible. When the plant is young, however, a larger proportion of this substance is digested than when the plant is mature. Its value in green fodders is somewhat less than that of the nitrogen free extract. When assimilated by the animal it is utilized for the same purpose as is the latter class of compounds.

SORGHUM.

This plant gave the largest yield of any of the forage crops. The variety used was Early Amber. There are several different varieties suitable for producing forage. In selecting a variety for this purpose the qualities most to be desired are rapid growth and abundant yield. In this state the amber canes exhibit this property to a greater degree than any others.

Sorghum will grow on almost any Nebraska soil. It gives better yields upon exhausted or worn soils than does corn. It also resists drouth and hot winds much more successfully.

In planting, the press drill may be used as for small grain, or it may be broadcasted. Sow at the rate of one and one-half to two bushels per acre. The former method is generally preferable, as the seed, if well covered with soil and pressed down, will germinate more quickly and more certainly than when left uncovered. If sown broadcast it is well to follow

Digitized by Google

with a harrow in order to cover the seed as much as possible. It may be successfully sown at any time during the summer, provided there is a reasonable amount of moisture in the soil.

Sorghum cannot be used for early forage. It is of tropical origin and will not stand cold weather. Do not sow, therefore, until all danger from frost is past. If the ground is not warm, the seed will be slow in starting, and even after the plants are up they grow very slowly if the weather is cool. This gives the weeds an opportunity to get possession of the ground, to the detriment of the sorghum. In most cases of this kind it will be best to plow up the crop and replant. If the seed be planted in rows, as with a press drill, it may be harrowed after the plants are well set. This will be of use both to destroy weeds and to loosen the soil should it become compact on top.

The crop may be pastured three or four weeks after sowing, but, as indicated by the previous experiment, more forage is obtained at a later date. It is advisable, therefore, to have a field of sufficient size, in proportion to the number of cattle pastured on it, to allow continuous pasturage, there being no danger of waste of forage unless the plants become so far advanced that the heads begin to ripen. If this plan be followed, the plants eaten down will start a regrowth, which it has been shown, affords more forage than does the first growth. It also has the advantage of requiring but little fencing, which saving will more than counterbalance the loss occasioned by some of the crop going to seed.

There is some danger attendant upon pasturing sorghum, particularly if the cattle have not previously had access to succulent fodder. Care should be taken that too much of the forage is not eaten when the stock is first turned on. This may be prevented by feeding them in the morning before turning out to pasture. After they have become accustomed to the pasture there is practically no danger, provided they be kept on it continuously.

Sorghum is not well adapted for late pasture as it is very easily spoiled by frost, after which it should not be pastured. Its great value is as pasture during July, August, and September, when it affords a large quantity of succulent forage that has a marked effect upon the milk flow.

Chemical analyses made of the entire sorghum plant at different periods of its growth would tend to confirm the results obtained from actual tests of its feeding qualities at such times. Dietrich and Koenig* give the following as the composition of the dry matter of the sorghum plant at the stages indicated:

	Protein.	Fat.	Nitrogen free extract.	Fibre.	Ash.
Before heading out.....	14.26	.....	50.82	28.85	6.07
Heads forming.....	7.59	6 65	59.19	23.22	3.35
Heads formed.....	13.09	2.37	49 03	24.17	11.34

* Zusammensetzung und Verdaulichkeit der Futtermittel.

Digitized by Google

It will be noticed that the protein, which for milk production is the most important constituent of the fodder, is greatest before the time of heading out. While the heads are forming there is a great falling off in the amount of this substance. After the heads are formed it increases in amount, but at this time it is largely in the seeds, of which a large proportion pass through the animal undigested. Although sorghum is usually regarded as essentially a sugar plant, yet we thus find that in its early stages of growth it compares very favorably in protein with blue grass.

THE COW PEA.

This plant is grown largely in the South, both for green forage and for hay. At this station it gave a remarkably heavy yield. As it is of southern origin it thrives under a high temperature and cannot be planted until all danger from frost has passed. It may, however, be sown at any time during the summer. The seeding is best done with a grain drill at the rate of one bushel per acre. It affords late forage or pasture, but of questionable value.

IMPORTANCE OF EXPERIMENT STATIONS AND SCIENTIFIC KNOWLEDGE TO THE FARMER.

The claims of science as an aid to the industries should no longer assume the apologetic tone. The day of uncertainty as to the possible good which science has to offer the industries is past. Schools of applied science and experiment stations have necessarily become fixed factors in industrial progress. Modern conditions and competition demand exact knowledge. Tradition, superstition, and mere opinion no longer have weight. The literature of agriculture bears evidence of the truth of these assertions, as does the best type of practice. There are several directions in which we see evidences of the value and necessity of the experiment station, some of which are as follows:

The chemical control of the immense fertilizer trade of this country, amounting to $2,000,000 per year, at a cost to the farmer of at least $600,000,000.

The ventilation of frauds which have in the past so largely taken the farmers' money without adequate returns.

The study of food problems.

The official chemical control of a large proportion of the immense dairy business which is done in this country through the aid of the Babcock test.

The application of economic entomology to horticulture.

The discovery of the causes of plant diseases, with the working out of the spraying methods for their prevention.

It is scarcely possible to sum up in a few words the large money return, which we are now receiving from these uses of scientific knowledge, to say nothing of the general uplifting and broadening of the agriculturist's

Digitized by Google

thought. Any occupation comes to have attractiveness and dignity somewhat in proportion to the knowledge and intellectual ability which it requires of its followers.

A FEW PARAGRAPHS OF INTEREST TO THE FARMER.

Gound once well plowed is better that thrice poorly.

One animal well fed is of more value than two poorly kept.

A strong horse will work all day without food, but keep him at it and he will not last long.

SEALING WAX FOR CANS.—Three-fourths of a pound of rosin, two ounces of gum shellac, and one ounce of beeswax.

BROOM CORN.—A ton of broom corn will make 1,200 or 1,300 brooms. It is worth $50 a ton, besides the seeds. It is a great crop in the Mohawk Valley.

Fence posts, steeped in a solution of blue vitriol—one pound of vitriol to forty pounds of water—will last forever, and be pretty good after that.

TO CURE SCRATCHES ON HORSES.—Keep the fetlocks clean with castile soapsuds, and then wash them twice a day with buttermilk. Give them a good rubbing at each time.

CURE FOR GARGET.—A tablespoonful of saltpetre given to a cow once a day, for three or four days, is an effectual remedy for the garget. It can be given in a mash, if the cow is hearty, or in a dough pill.

A decoction of strong soapsuds with tobacco stems (the more tobacco the better) will exterminate the red spider and all other insects from all plants and shrubs without the slightest danger of injury.

A CERTAIN CURE FOR A RATTLESNAKE BITE.—Take the yolk of a good egg, put it in a teacup, stir in as much salt as will make it thick enough not to run off, and spread a plaster and apply to the wound.

STARTING TOBACCO PLANTS.—Nothing better to give tobacco plants a good start than a tablespoonful of good superphosphate of lime to each hill, thoroughly incorporated with the soil at the time of setting.

PRESERVATIVE AGAINST MOTHS.—A small piece of paper or linen just moistened with turpentine, and put into the wardrobe or drawers for a single day, two or three times a year, is a sufficient preventive against moths.

As soon as the leaves of the currant and gooseberry are fairly expanded the "worm" may be looked for. The eggs are laid upon the under side of the lower leaves, and if these are removed and destroyed much trouble is averted.

CURE FOR CHICKEN CHOLERA.—Take wheat bran and mix with equal parts of lye soap and grease, until well mixed, and feed every morning for ten days. If the chickens are attacked, and still able to eat, the above mixture will cure them.

WHAT TO DO WITH ASPARAGUS BEDS IN WINTER.—When the old straw is dead, cut it off and use it to burn clay and stuff. It is good for nothing

Digitized by Google

else; it is bad to rot down. Then cover the bed three or four inches deep with the dung of an old cucumber bed. Pat it down gently; and then sift on top just as much sand or light soil as will hide the dung. When the grass comes up in spring don't cut it as soon as you can see its nose, but let it grow three or four inches high, and then cut it. When you cut it use a long, narrow, sharp, straight knife.

CARBONACEOUS LIQUIDS.—All liquids containing carbonaceous matters are highly valuable for irrigating plants. Cow excrement, soaked or macerated in water by placing in a half-hogshead, tub, or other suitable vessel, and exposing it to the sun for twenty-four hours, will furnish a most valuable stimulant, and one that may be applied with advantage to every species of crop. Hen manure, macerated in the same way, will, when applied to cucumbers, squash, and other similar vines, protect them from the ravages of the bug, and tend also greatly to promote their growth.

WHAT DO YOU DO WITH SOAPSUDS?—Although generally deemed only fit for being run into the common sewer in the easiest and most expeditious manner possible, they are, nevertheless, highly beneficial to vegetable feeders as well as useful insect preventives. Hence they should never be wasted especially by those having gardens. Their application to the ground, whether in winter or summer, will show beneficially, not only on berry bushes, shrubs, border flowers, but even window pot-plants; while if poured or syringed over roses, cabbages, etc., they will prevent, or at least mitigate, the mischievous doings of the green fly or caterpillar.

TREES ON NEBRASKA PLAINS—ARE THEY INCREASING OR DIMINISHING FROM NATURAL CAUSES?

BY PROFESSOR CHAS. E. BESSEY.

The question, "Are trees receding from the Nebraska plains?" is the subject of an instructive paper by Professor Charles E. Bessey of the State university in a late issue of Garden and Forest. Professor Bessey says truly that the question is of "no little interest, both botanically and economically." The changes he notes do not include changes wrought by man, but the "slow changes due to natural causes, and having nothing whatever to do with men's activities.

There are, all told, he writes, sixty-five species of trees which grow naturally within the limit of the state, yet for a great part of its area but a small per cent of these are to be found in any particular locality. The greatest number occurs in the southeastern corner of the state, and from this point the species decrease as we pass northwesterly. To particularize, as we enter the state at its southeastern corner we find that there are ten species of oaks, but after traveling sixty to sixty-five miles westward or northwestward we find that there are but two species, and within a few kilometers (five to ten miles) one of these disappears, unless we follow the

Digitized by Google

bluffs of the Missouri northward. The trees of the walnut family present a similar interesting distribution. The black walnut has extended its range along the south line of the state, in the Republican valley, for 200 to 220 miles, and northward along the Missouri and Niobrara rivers for fully 435 miles. The butternut, on the contrary, does not extend more than sixty to seventy-five miles from its point of entrance. The shellbark, the big hickory-nut, and the pig-nut have little, if any, greater range than the butternut. So if we take up almost any of the species they are found to have entered the state from the southeast and to have passed northward and westward to greater or less distances. There are, however, a few species (nine in all) which seem to have entered from the west. One is the buffalo berry, *shepherdia argentea*, which is scarcely entitled to be called a tree, since it rarely attains to either the form or dimensions of one; it has, however, succeeded in traveling further than any other of the western arboreous species, reaching the Missouri river on the east and the Republican on the south. The next in extent of distribution is the yellow or bull pine, which enters the state at two points and stretches eastward for long distances. Near the northwestern corner of the state, Pine Ridge, with an elevation of 4,600 feet, extends eastward from the Wyoming mountains, and after about ninety miles passing over the line into South Dakota. On this elevated ridge, which is quite mountainous in many places, the yellow or bull pine is found in abundance, and it has passed from the ridge to the abrupt and rocky bluffs of the Niobrara river, down which it has extended to within less than sixty miles of the river's mouth. About seventy-five miles south of Pine Ridge is a similar but higher uplift of land, Cheyenne ridge, which extends eastward between the North Platte and the Lodge Pole rivers for a distance of nearly 125 miles. Its highest points, known locally as the Wild Cat mountains, attain an elevation of about 5,300 feet, and from these the ridge descends gradually to 3,700 feet at its eastern extremity. Upon this extended ridge this pine has extended for at least ninety miles. It is found also in widely isolated canyons in the central part of the state, near the eastern border of the great sandhill belt.

INVASION OF NEW TREES.

The following trees, which have invaded the state from the west, have followed one or the other of these two ridges. Thus the quaking aspen (populus tremuloides), black cottonwood (populus angustifolia), mountain maple (acer glabrum), and canon birch (betula occidentalis), follow Pine Ridge for from ten to seventy-five miles. On Cheyenne ridge Rydberg's cottonwood (populus acuminati) has pushed in from the Wyoming foothills for a distance of from ten to fifteen miles. It is interesting to mention here that the very pretty smaller mountain mahogany (cercocarpus parvifolius), which further southwest becomes a small tree, enters the state on Cheyenne Ridge, where it grows luxuriantly as a rather tall spreading shrub on the precipitous slopes of the Wild Cat mountains.

Looking over the whole area and studying attentively the condition of the trees along the borders of the areas which they occupy we may ask

Digitized by Google

whether they are advancing or retreating. At one time I held the view that the eastern trees were advancing and the western retreating, but further examination has somewhat modified this view. Along the western border of the area occupied by the bur oak (quercus macrocarpa), the trees are found upon the sides of the narrow valleys through which flow the creeks and rivers. These trees are young and vigorous and have every appearance of having obtained recently a foothold. Further down these streams the trees are larger, and finally we come to groves of mature trees. The same facts may be observed with less emphasis with regard to the red oak (quercus rubra), black walnut, bitter-nut hickory (hicoria minima), Kentucky coffee tree (gymnocladus dioicus), honey locust (gleditsia triacanthos), green ash (fraxinus lanceolata). All of these species appear to be moving westward, the trees of the most westerly stations being nearly always young and vigorous.

PINES MOVING EASTWARD.

With the western species it is nearly the same. While at some stations the pine trees upon outlying borders are apparently the remnants of a former larger growth, in many other places these outliers are growing and vigorous. This was particularly noticeable in a recent visit to Cheyenne Ridge, where but one explanation could be given for the present distribution of individual trees upon the spurs and hillsides. It is very certain that upon Cheyenne Ridge the pines are slowly pushing eastward, and that, in spite of the ravages of man and of herds of cattle, horses, and sheep, this species is more than holding its own. Upon some parts of Pine Ridge man's interference has checked the advance of the pine, and this is the case also in some places along the Niobrara river; but in many other places the young trees are springing up and vigorously contesting with grasses and weeds for the possession of ground. The mountain maple and the canyon birch give one the same impression of a successful and comparatively recent advance into a territory formerly unoccupied. Even the shrubby mountain mahogany upon the slopes of the Wild Cat mountains is evidently fighting a winning, and not a losing, battle. No one can ride through the mountain canyons and see the vigorous plants of this pretty species and come to any other conclusion than that there is here a strong eastern advance of a western species.

With respect to some of the trees upon the Nebraska plains I have to admit that it is at present impossible to see either advance or retreat. It is probable that in some instances, as, for example, the paper birch (betula papyrifera), the trees have remained where they are for ages, without perceptible change in area. Perhaps we have in this tree a survival of the glacial migration from the far north. Likewise, I find it impossible to pronounce upon the status of the basswood, cottonwood, elm, silver maple, buckeye, cherries, etc. They have as yet not shown anything which is conclusive either way.

From such evidences as we have thus far, it is evident that some of the eastern trees are advancing toward the west, and that some of the western

Digitized by Google

trees are advancing eastward. In other words, we can say that some of the species are not receding from the Nebraska plains, and that as to the other species the evidence of advance or retreat is not wanting.

THE PROBLEM OF THE SHEEP INDUSTRY.

[Paper by E. D. King, Burlington, Kas.]

Forty years with sheep, eighteen of which have been spent in Kansas raising first grades, then pure Merinos and pure Shropshires, and feeding all classes of natives and Western sheep for market, have taught me that there is no problem to be solved in the sheep industry in Kansas, but that any man of reasonable patience and industry can succeed in any part of the state. Sheep love a dry soil, rolling land, and a sunny sky. These are the birthright of Kansas. Rich grasses for summer and generous grains for winter, Kansas can give in as rich measure as any land on earth. The poorest acre in the state is as well adapted to sheep as the chalky downs of England, where her best breeds originated. The richest acre we have is not too high-priced for their profitable production. If alfalfa, cane, and Kaffir corn be provided for bad weather in winter, the western part of our state is an ideal breeding ground for thousands of sheep, to be fattened on the surplus grains of our eastern counties, and on our eastern border is a market which never gets enough good mutton. Kansas cribs in the average year are groaning with a plethora of corn, which cannot be moved without a loss to the producer. When the market won't pay 50 cents for wheat it is worth that to feed lambs. We are furnishing all the cattle, hogs, and horses the market wants, but the supply of good sheep is short, and we are not raising half the wool our mills consume. Let there be such a lack of wheat or corn as there is of sheep, and our farmers would strain every nerve to supply it to the impoverishment of their farms, which would be yearly growing richer if they were pastured by sheep and the surplus grain fed to them. The sheep from our western counties, and from the plains and mountains beyond, find their most profitable feeding ground here, where they can be stopped on their way to market on a "feed in transit" rate and finished and go on as our farmers' manufactured product. If it is usually profitable to work up raw material into a finished product, it is certainly profitable for our farmers to work up their raw material and secure the triple profit of the manure, the fleece, and the additional price for ripened mutton. Yet the farmers of Michigan and Ohio are buying them and paying the extra freight and an extra commission and yardage charge, and feeding on higher-priced feeds, and making money. Why do Kansas farmers allow their advantage in this matter to slip away from them? Sheep do not get the cholera, which wipes out a year's work in a night.

If a grain crop should fail there is usually coarse feed in plenty on which they can be carried through until another year and give a crop of

Digitized by Google

wool which will more than pay their keep. If one dies he usually has wool enough on him to pay what he has cost that year.

Only a small capital is required for any farmer to feed a few sheep. Some poles covered with hay or straw for shed, a few racks, or, if these can not be had, some fence panels around a hay stack to feed coarse feed behind, a few troughs for shelled corn when it is muddy, the rest of the time feed shock corn on the dry ground, for the sheep does not need its grain either husked, shelled, or ground. They are emphatically the stock for the poor man who must start with few conveniences, and if he will stay by them they will build him a comfortable house and ample barns to shelter all the feed and stock the best farm in Kansas can produce. Where it can be done, it is an advantage to bring Western sheep in early and give them a few months pasture to domesticate them and fill them out. In some cases I have carried the ones that did not feed out well over to another year, and the improvement was most marked. They rounded out and were about as good as good natives. As the pasture dries in the fall, gradually bring them onto grain, then turn them into the cornfields, where they will clean up the weeds and grass much better than the hired man will, and gather their own corn without any waste if the ground is dry. They can be put on the market in November or about December 1, before many grain-fed sheep come in. The price then is usually good. Another lot can then be put in the yards, and, if light-fleeced, should be fed for February if heavy-wooled they should be shorn in April and, after removing the fleece, they will put on flesh very fast and may be finished for May, coming in between grain-fed and the grass sheep and usually finding a good market.

As to the kind of Western sheep to feed, it does not make much difference. Those that have had a Down cross sell well finished and healthy, but, true to the inbred characteristics of their sire, they fatten best on grass and silage and turnips and do not relish all dry feed. If mutton lambs are raised on the farm, the most profitable way to handle them is to have them dropped early in a creep. Wean early, feed grain on grass, and put on the market while the juicy grass is still in their tissues.

For finishing entirely on dry feed the New Mexican sheep are the best we can get from the West. They kill out well, dress a good per cent, and the buyers like them at an extra price. The descendants of the hardy Merino left there by the early Spanish explorers, they have always been accustomed to dry feed and hardship and respond quickly to good feed and care. They do not make as heavy weights, but the market is usually as good for the "handy sheep" of eighty to 100 pounds, if fat and smooth, as it is for heavier ones, and often it is better. The day of bulk is past, the era of quality and finish is coming in.

Sheep should be brought onto feed gradually for ten days to two weeks until all get to eating, then feed a bushel daily per hundred head for thirty days; for the next thirty days two bushels daily per hundred head and for thirty to sixty days more, three bushels daily per hundred, given in two or three feeds, observing the most careful regularity in the time

Digitized by Google

and manner of feeding. The sheep is a clean animal, and all troughs should be swept clean for each feed. Pure water in clean troughs should always be by them, and barrel salt. Good natives or acclimated sheep do not need a longer feeding period than ninety to one hundred days, especially on corn. Sheep direct from the range should be roughed sixty to ninety days on a light grain ration and plenty of good forage. They will make good gain for some time on clover alone.

When bran or oats are cheap a mixture of half of either one and half of corn is good feed to start them. As soon as they are all eating corn there is no better or cheaper feed than shock corn, varied once or twice a week with a feed of sheaf oats. When on full feed of shock corn the fodder will make the roughness they need, but they will do better with one feed a day of clover or alfalfa. Prairie hay or any kind of straw or flax straw will do for roughness. They do better to change the forage often. They do best on a mixed grain ration, but with cheap corn and high-priced nitrogenous foods I would only feed them for an occasional change or not at all and supply the nitrogen with clover and alfalfa. Clover and corn go admirably together, and the best rotation for our farms is corn followed by oats and clover. Cut a crop or two of hay, pasture while the clover lasts, with sheep, then corn again, and the land will always be productive. By raising clover or alfalfa to balance the corn we don't need much purchased feed. I have never fed shredded corn fodder. It seems to me wasteful to lose one-half of that valuable plant as we do in feeding it whole. If I knew it would nearly all be consumed by sheep when shredded, I should certainly put in a shredder. If any one here has tried it I should like to have his experience. That is what this meeting is for—to swap experiences.

But it is not on feeding ground alone that we would consider the sheep industry in Kansas. The larger portion of the sheep in the United States are now raised west of us, and always will be, and no state is so well fitted as Kansas to raise the rams they need. We have as good advantages as any state for that business and better than most. The buyer don't have to go so far from home nor be at as much expense. We have as good blood as any state, but we need more flocks. The sheep, owing to our better climate and grasses and less confinement in bad weather, grows larger than his eastern brother and shears a heavier fleece and longer staple, and owing to his better development and being acclimated to western conditions, is worth at least double for the first year's stud service.

I shall always claim that every farm in Kansas, no matter if it contain but forty acres, should keep some sheep, just as it should keep some poultry, and for the same reason—because they clean the waste and bring in more profit for the little trouble and expense they occasion than any other stock we keep, except the hen. Notice any of our prairie pastures in which cattle and horses are kept. Within three years the weeds are ahead of the grass. Put the same number of sheep in that there are of cattle and it will be better pasture for the cattle than before and keep the sheep besides. The sheep will eat the weeds the cattle reject and give the grass

Digitized by Google

a chance to occupy the ground around the barn. In the winter they will glean the waste, and with a little coarse feed and an ear of corn a day keep in good shape. Twenty-five good ewes will shear 250 pounds of wool, worth to-day 15 to 20 cents per pound, and will raise twenty-five lambs (in a small bunch there being twins enough to make good all losses).

If these are mutton lambs and dropped early, they can go off of grass with a little extra grain at $4 each. If from a Merino ram, the wether lambs should be fed and shorn for spring market, and are worth from $4 to $5 each to keep in the flock. I have sold this fall ewe lambs from fair grades and Merino rams at $5 to start flocks.

Hired labor is our greatest expense. If the farm is a little too large to work alone, a cheap fence around the rougher or poorer portion will enclose a few sheep, which the children can bring in at night to shelter from the coyote and dog. They will enrich the farm in fertility and the pocketbook in cash faster than any other stock.

In starting the farm flock, remember that the ram is three-fourths of the flock. Select him of the breed you like best. Be sure he is of pure blood. Get him of fair medium size for the breed; nose broad, nostrils wide, head short and broad and carried as if he knew his lineage and was proud of it, eyes prominent, neck short and broad and rising from the shoulder, back straight and broad, barrel round, quarters heavy, straight, heavy-boned legs at each corner of him, and covered all over with a fine, even, and dense fleece, pretty oily for the breed (oil and breed are closely related).

There never was a more opportune time to engage in sheep husbandry When I left Michigan, for Kansas, nearly every farm had its flock of sheep so had the farms of Ohio and most of the eastern states. To-day those farms are mostly bare of sheep. The few who have kept them claim they pay better than anything else, and the rest are all looking for sheep.

As I rode through the country this fall I met the farm wagons scouring the country for lambs at 5 cents per pound, off of grass. These lambs could be raised here at half the cost they can there and would be nearly clear profit. You and I will never live to see a ewe that can raise a good lamb sell for a poor price. Again, the mutton lamb is wanted to eat, the Merino lamb to replenish the flocks that must clothe us and raise more lambs to eat.

The American people are fast becoming great mutton-eaters. It will take more than the annual increase of the flocks of the United States to supply the annual demand for mutton. We are not raising one-half our wool. What folly for us to send our money abroad and pay freight back on either wool or mutton while our farmers are suffering for lack of the money this added industry would bring them and need the market the flocks would make for their surplus feed. Every additional branch of industry, whether on the farm or in the factory, calls for more mouths to feed, more hands to work, and is felt for good through all our social fabric.

For the ewes of the farm flock, I would secure the best grades I could. To get them at present a man would have to take a mixed lot. I would

Digitized by Google

breed them to a well-formed, fleecy Merino ram until I had secured a uniform type of medium-sized black, hardy ewes, with a rent-paying fleece. I would use this type of ram because I would secure a heavy fleece quicker and a hardy foundation animal with a fleece dense enough to exclude dirt and storm. Density of fleece is an important point from central Kansas west. You will notice that an open fleece is injured by the alkali dust, which penetrates the open fleece and gives it a bad, dead end. While pursuing this I would fatten yearly wether lambs and the ewe lambs which did not come up to the standard, which should be advanced a little higher each year. Also fatten the ewes that did not prove desirable. Now, having laid the foundation deep and secured a paying fleece, if I desired to raise mutton lambs I would use the best pure-bred sire I could get of that mutton breed I liked the best. Provide good shelter and have the lambs dropped in March. Feed a little grain in lamb creeps as soon as they will take it, wean early, feed well on grass, and sell off of grass, wintering only breeding stock.

The production of wool has about reached the limit in Australia, and, according to recent communications from Minister Buchanan, it is not likely to increase further in South America.

Civilized men will always wear good clothes. More wool in proportion to population will be used as we grow older. As the area devoted to it cannot be increased, it must pay better to raise it. The farmers of Kansas are standing in the front rank in the production of all other kinds of stock; so, too, they should of sheep.

Our Kansas farmers can keep millions of the needed sheep without displacing a single head of other stock, and without crowding the "Beef Steer and His Sister."

Our country needs the sheep. Kansas has everything the sheep needs in fuller measure than any other state in the Union. We need not one woollen factory here in Topeka, but a dozen in the state, and not let their wool be freighted from Mexico to St. Louis and freighted back, and pay two or three commissions, but let the Kansas farmer haul Kansas-grown wool with a Kansas-raised team, in a Kansas-made wagon, to a Kansas mill, whose Kansas-born operatives shall consume Kansas-raised butter, eggs, wheat, and garden truck, making a market for still other Kansas farmers.

Start the merry click of the shear within sound of the busy spindle's hum, and let us pledge not to sleep under a blanket nor wear a suit of clothes that is not made from Kansas wool in a Kansas mill, and thus encourage in our state an industry which will never dishonor any reasonable draft made upon it.

Digitized by Google

CORNSTALK DISEASE.

By A. T. Peters, State Veterinarian for the Board.

The term "cornstalk disease" has come to be so generally adopted that it will probably always be used to designate that disease caused by allowing cattle to feed on the dry stalks left standing in the field after the corn has been picked in the fall. It is a very common custom, especially in Nebraska, for farmers to turn their stock into the cornfields to pasture on "roughage," as they call it. This disease is probably the cause of more loss to the farmers of Nebraska than any other malady, with the exception of swine-plague. Cornstalk disease is prevalent not only in one state, but all through the corn-raising states of the northern and middle sections of the Mississippi valley. "It is seen in all parts of Nebraska, on the Missouri bottoms, the high rolling table lands, the Logan valley, the Elkhorn valley, and country lying between them." * It does not sweep through a whole neighborhood, or even a whole herd, but seems to attack cattle here and there, sometimes picking out only two or three head from a herd of forty, and at other times taking as many as ten to thirteen. It does not usually appear on adjoining farms. A great many farmers have never lost an animal from this cause, while their neighbors have lost several head under apparently the same conditions.

Just how long this disease has existed in this country it is impossible to tell. Farmers claim to have experienced its ravages as early as 1865, but the earliest accurate knowledge of the disease is found in the investigations of Professor Gamgee in 1868–'69.† Further investigation was not reported until within comparatively recent years.

The exact cause of the disease is as yet shrouded in mystery. Each of the numerous theories advanced has found and still holds its supporters. The object of this article is to give the theories that now prevail, the symptoms of cornstalk disease, and the method of prevention.

CORN SMUT.

One theory of the cause of cornstalk disease that is greatly discussed, and probably one of the oldest, is that the trouble is due to the cattle eating corn smut. Professor Gamgee, in the report referred to above, records an experiment with smut as follows: ‡

"One cow was fed thrice daily one and one-half pounds of cornmeal and three ounces of smut, mixed with as much cut hay as she would eat. The second had the same allowance, but wet. The amount of smut given in each case was increased to six ounces. The cow fed on dry food lost flesh. Eight days later the dose of smut was increased to twelve ounces three times a day. The cow on the wet food gained in condition, the other one lost. In three weeks the two cows consumed the forty-two pounds of smut.

* Dr. V. Schaefer, a paper read at Nebraska State Veterinary Association, at Omaha, September 1, 1896.

† Report of the Commissioners of Agriculture on Diseases of Cattle of the United States, Washington, 1871, page 73.

‡ See note 2, page 51.

Digitized by Google

They had a voracious appetite the whole time, and the only indication of a peculiar diet was a very black color of the excrement and the loss of flesh by one animal, although liberally fed on a nutritious diet, which, however, was given in a dry state. * * * It is evident that smut is not a very active poison in combination with wholesome food, and especially if the animal is allowed moist food and plenty of water to drink."

An investigation of similar nature was made at the Illinois Experiment Station.* "To ascertain whether the smut was responsible for the disease, about sixty pounds of it were collected and fed to a grade Jersey steer, with grain and hay, as follows:

From December 13, 1889, to January 2, 1890, 120 pounds of grain, 105 pounds of hay, 20 pounds of smut, and 371 pounds of water were given. From January 2 to January 24, 1890, 176 pounds of grain, 135 pounds of hay, and 39 pounds of smut were fed and 366 pounds of water given. When the experiment was begun, December 13, 1889, the steer weighed 560 pounds. January 2, 1890, he weighed 551 pounds, and January 24, 555 pounds. No evidence of disease was discovered.

Dr. F. L. Kilborne records two experiments to test the effects of corn smut. In the first case the smut used came from a field in which several animals had died within five days after they had been turned into it.† Three two-year-old steers were fed exclusively on smut-laden stalks and free smut, mixed with a small quantity of a mixture of cornmeal and wheat brand, for seven days without ill effects. This report states: "It is safe to say that these animals consumed a much greater quantity of smut than the animals which died in the fields."

In the second case two heifers were fed, in addition to grain and hay, sixteen quarts of smut morning and evening for sixteen and one-half days. The animals appeared to be perfectly well throughout the time of feeding and continued so for several months.

Dr. N. S. Mayo records the experience of a farmer near Manhattan, who gathered the smut from the field and placed it in an enclosure.‡ "One night the cattle broke into the enclosure where the smutty corn and smut had been thrown out and ate all they wished; no injurious effects were noticed."

Professor C. D. Smith has completed experiments along the same line, in which four cows were fed varying quantities of smut. § Two of the animals were fed in as large doses as they could be induced to receive, the dose being increased gradually until two pounds were fed to each for twenty-four days. This dose was then increased one pound per day for a week, when the experiment closed, each receiving eleven pounds on the last day.

The other two began on two ounces a day each, and received gradually increased doses until one pound a day was given for thirty-three days.

* Cornstalk Diseases and Rabies in Cattle. U. S. Dept. of Agr. Bureau of Animal Industry. Bul. 10, January, 1896.

† Cornstalk Diseases and Rabies in Cattle. U. S. Dept. of Agr., Bureau of Animal Industry. Bul. 10., page 47, Jan., 1896.

‡ Kansas Ex. Station. Bul. 58. June, 1896, page 68.

§ Mich. Ex. Station. Bul. 137, Nov., 1896, page 43.

Digitized by Google

All the cows were pregnant, but no signs of abortion appeared. The milk production was regular and constant, and did not vary in yield. No injuries whatever were sustained by any of the animals from eating the smut.

At the Farmers' Institute at David City last year a gentleman stated that he had often heard his neighbors say, and he had also read the same in agricultural papers, that cornstalk disease was caused by cattle eating smut. He had the opportunity to make the test for himself. He was compelled to clear the farm he rented of the smut. His son gathered the smutty stalks into a yard where two cows ate considerable of the smutty leaves. No bad results followed, as witnessed by the gentleman himself and the owner of the place.

From the foregoing instances I feel certain that corn smut has nothing to do in bringing on this disease.

"SHORT-OF-SALT-AND-WATER" THEORY.

Another that has existed for many years and still has many adherents is the "short-of-salt-and-water" theory. These adherents claim that the animals die in the stalk fields from a lack of access to fresh water and sufficient salt.

Dr. F. S. Billings cites many instances where farmers have lost cattle from cornstalk disease that had plenty of water and salt.* Personally I have met with many similar instances. So I am led to believe that the lack of salt and water is not the cause of cornstalk disease.

DRY MURRAIN.

The theory of the majority of stockmen who have investigated this disease is that death is caused from "dry murrain." As far as I can trace this the farmers have come to this conclusion from the fact that they have found the third stomach, on post-mortem examination, to be in a hard, dry condition. Now, the truth is, the natural state of this stomach is dry and hard, and so they have been led to think that this was a morbid condition.

SALTPETER.

Dr. Mayo reports cattle dying from eating corn fodder that contained potassium nitrate or saltpeter. He describes how an excess of saltpeter in cornstalks may be detected.† If such a stalk be lighted it will burn and crackle like the fuse of a firecracker. In a certain instance he found that "beneath the leaf sheath which surrounded the stalk just above the joints, the nitrate had crystallized in fine, white crystals, which resembled a white mould, but was easily recognized by tasting with the tongue. Around in the cut end of the stalk were solid masses of almost pure potassium nitrate. If a stalk were cut in two and tapped lightly upon a table, the crystals of potassium nitrate would be jarred loose and fall as a fine powder upon the table."

* Neb. Ex. Station. Bull. 8, 1889, pp. 174 and 175.
† Kan. Ex. Station. Bull. 49, 1895, p. 5.

Digitized by Google

We have examined various cornfields where cornstalk disease prevailed, and in no case did we find potassium nitrate in sufficient quantities to warrant us in giving this as the cause of the disease. The theory that this is the cause of the disease has not been generally held since it is known that this is one of the chemical constituents of cornstalks. And besides, cattle can take with impunity a great amount of this as a medicine, more than is taken by eating the cornstalks, except in the rare case cited by Dr. Mayo, where the stalks had been grown under peculiar conditions near the barn, where excessive amounts of nitrates could be absorbed.

E. A. de Schweinitz, who has made chemical examinations of stalks from fields in which cattle had died from cornstalk disease, says in regard to the presence of potassium nitrates: "Those that we examined contained only a minute trace of the nitrate, so that if in any of the instances the cornstalks were the cause of disease in the cattle, and our samples were fair specimens, the poisoning was not by the salt."*

These analyses by him further showed that toxic properties were not present in sufficient quantities to produce disastrous results.

GERM THEORY.

The "germ theory" is that the disease is due to a bacterium. This was first advanced by Dr. F. S. Billings, formerly of the Nebraska Experiment Station. He believed that the cattle died from the effects of eating cornstalks infected with a germ known as the "Burrill bacillus."

In 1889, Professor Burrill described † a bacillus that attacks cornstalks in the following way. ‡ "(1) The young corn is first affected in the roots, and (2) full-grown stalks after midsummer, when it manifests itself by certain discolored areas, more particularly on the leaf sheaths. Attacking the young plants, it dwarfs the stalks, destroying the crop, while in the mature plant it is widely distributed and does not appear to be of economic importance."

In January and March, 1888, and in February, 1889, Dr. Billings examined material from cattle that had died while feeding in cornstalks. § He succeeds in isolating, in each case, a germ supposedly identical with that described by Professor Burrill as affecting cornstalks. Inoculations were made by Dr. Billings from cultures obtained from the above material, with the result of death in rabbits, guinea pigs, and mice. A rabbit fed with a pure culture died in four days, pure cultures of the germ were obtained from each of the organs. A calf and a hog were inoculated with this material. The hog remained well, while the calf became excessively emaciated. From this same animal pure cultures were obtained.

According to these reports Dr. Billings is justified in affirming that the animals died from a bacterial disease. The next step was to discover how the animals became infected. He accordingly obtained leaves from the cornstalks taken from the field in which the animals had died that were

* P. 88 of U. S. Bull. referred to in note 2, page 51.
† Ill. Ex. Station. Bull. 6, 1889.
‡ P. 39 of U. S. Bull. referred to in note 2, page 51.
§ Neb. Ex. Station. Bull. 8, June, 1888, p. 178+.

Digitized by Google

examined in February, 1889. By feeding these leaves to a rabbit he produced a disease of which he obtained pure cultures of the germ, "the same as that found in the cattle, so far as we could judge from a microscopical examination."

Dr. Billings' opinion is shown in a popular article that recently appeared. He states, "It is now six years since I first discovered a germ in cattle sick and dying from being turned into stalk fields.* In many cases I have carefully examined the whole field, and in some of the worst outbreaks smut was conspicuous by its almost total absence. * * * Not only in every case personally examined, but in still more where blood and organs have been sent me, have I isolated one and the same germ, but have repeatedly produced the disease in cattle with inoculations of pure cultures. Some six weeks since I received some corn from a field in which cattle were dying in Indiana, and in this corn I found the same germ. I inoculated rabbits with some small fragments of the diseased corn and it killed them, and from them I made pure cultures and injected two cubic centimeters into the jugulars of two cattle, with the result of killing one and making the other very sick, getting the same germ from both."

It is held by Dr. Billings that this germ is identical with that described by Professor Burrill, but later investigators have demonstrated that cornstalks infected with the Burrill bacillus are wholesome food for cattle. For instance, Dr. Mayo made experiments to demonstrate what influence, if any, the diseased cornstalks had in the production of cornstalk disease. On July 13, 1891, he received from Professor Burrill a culture of the germ which produced the disease in the growing cornstalks.† Cultures were made from these, and inoculations made in growing corn. When these were thoroughly ripened they were gathered and fed to a two-year-old heifer. For eight days she was fed exclusively upon this inoculated corn fodder, which she ate readily. No deviation from a normal condition was observed. Beef-broth cultures were given in large doses to the same heifer without serious effects.

The fact that cattle can eat without ill effects cornstalks affected with the Burrill disease was further shown by the experiment of the Bureau of Animal Industry at Washington:

"A drought which extended over the greater part of the state of Illinois in August and September, 1893, dried up the pastures and compelled the farmers to feed their cattle.‡ In many instances cornstalks were the only food given. As all of the corn was found to be affected with this disease, it was evident that no feeding experiment could be planned that would be more efficacious than those already being made. Several herds of cattle that were fed exclusively on these stalks were carefully watched for a period of several weeks, but no evidence of disease appeared. The cornstalks fed carefully were carefully examined and found to be thoroughly infected with the Burrill disease. It should be noted that the cattle ate

* Breeders' Gazette, Vol. XXVI., 1894, p. 340.
† Kan. Ex. Station. Bull. 58, June, 1896, pp. 70 and 71.
‡ P. 42 of U. S. Bull. referred to in note 2, page 51.

Digitized by Google

these stalks much closer than they did dried ones in the field later in the fall, and consequently they ingested many more of the diseased areas. It is of interest to add that so far as it was possible to learn, the cornstalk disease did not appear among the cattle in 1893 in the districts visited in the fall, and where the mature cornstalks were known to be badly affected with the Burrill disease."

As mentioned above, these experiments show that the Burrill disease is not the cause of cornstalk disease. Furthermore, investigators, with the exception of Dr. Billings, have been unable to demonstrate the presence of any living organism as the cause of this disease. So I am of the opinion that the Burrill bacillus may not be identical with the bacillus discovered by Billings, and that the Billings bacillus may yet be shown to be the cause of the disease.

SYMPTOMS.

For a description of the symptoms of cornstalk disease, we must of necessity depend largely upon the farmers and stockmen, because, as a rule, a veterinarian is not called in time to see the animal alive, as the disease takes a very rapid course. "It is usually confined to yearlings and two-year-olds; although I know of farmers who have lost several milch cows within a few days. I have seen where the young animals would die in the fields and not affect any of the older cattle." *

The typical symptoms are as follows: the disease comes on suddenly, without any apparent warning. The sick animal is found apart from the rest, either lying down or standing. If standing, the back is usually humped up. Frequently there is a switching of the tail and a peculiar twisting of the rump, indicating a straining in attempting to urinate. The animal often shows pain in the abdominal regions by kicking at the belly. The eyes have a peculiarly brilliant stare, as if the vision were impaired. In the first stages the animal moves very reluctantly if disturbed. The gait is staggering and uncertain, with lameness and frequent paralysis of the limbs. If the brain is affected, the animal starts wildly at the approach of anyone, and becomes quite delirious, running about the field, sometimes running into a wire fence, which is quite uncommon for cattle to do. Not infrequently the animal will attempt to attack the attendant. The respiration is increased to 50–60 per minute. (Normal 10–15.) As we have observed, the general length of the course of the disease is from twenty-four to thirty-six hours.

By farmers this disease is rarely confounded with anthrax or blackleg of cattle, as the symptoms are well marked, since cattle that die with blackleg have the characteristic swelling on the shoulder or joints, which swelling crackles when the hand is passed over it as though air were beneath the skin. In anthrax the animals die very suddenly, and on post-mortem examination the blood is not coagulated, and the spleen is very much enlarged and gravitates. Carbuncles may also be seen on the skin. Rabies is more likely to be confounded with cornstalk disease, be-

* Dr. Schaefer in his article referred to in note 1, page 51.

Digitized by Google

cause we find similar symptoms, such as straining in attempts to urinate, delirium, and paralysis. But rabies comes at a different time of the year, during the warm season, and is generally accompanied with a mad-dog scare.

CORNSTALK DISEASE IN HORSES.

In the last few years extensive outbreaks of this disease in horses have been reported to this department. The symptoms are very similar to those in cattle. Generally the animal is attacked quite suddenly and dies in three or four hours from the time it was first noticed. One of the first signs is the appearance of dullness, at which time the temperature is about normal. Two or three hours later it is down to 97° F. (Normal 100°.) So at the time of death the temperature is quite low. The pulse at first is normal, but becomes weaker as the disease proceeds. The breathing is decreased to 10–12 per minute. Mr. Bastron, of Minden, Neb., describes horses as dying with eyelids closed and the tongue hanging out of the open mouth. The rectal muscles are relaxed. The animal finally dies without a struggle.

POST-MORTEM APPEARANCES.

We generally find the organs nearly normal, although the third stomach is a little harder than common. The brain in all cases we have found to be normal. The pathological lesions which presented themselves were as follows:

Liver enlarged; gall bladder distended; spleen enlarged and pale; kidneys pale, the capsule being very easily removed; third stomach firmer than usual; fourth stomach and duodenum congested; paunch and intestines in the same condition. Rarely there is a slight congestion of the lungs. The meat appears pinkish in color, indicating no intense fever.

In horses the contents of the stomach and intestines are found to be thin and watery in most cases. Stomach and intestines congested, though they may at times appear very light in color, having a light yellow tint. Liver generally enlarged. Lungs and kidneys somewhat congested. Heart normal. The brain seems a little softer than usual.

PREVENTION.

From answers to letters of inquiry sent out over the state, and from the personal experience of stockmen, we have concluded that the best method of prevention is to feed a grain ration to the cattle in the morning before turning them into the fields, or to allow the stock to have access to a hay or straw stack. The only safe method, however, is to cut the stalks and feed them in that form.

TREATMENT.

In most cases the disease is so far advanced when discovered that treatment is useless, but if noticed in time I would advise drenching with Epsom salts in half-pound doses every few hours until they act.

Digitized by Google

OUTBREAKS IN NEBRASKA.

A circular of inquiry was sent out to the various stockmen and veterinarians of the state, containing the following questions:

1. How many outbreaks of cornstalk disease have occurred in your vicinity?
2. How many animals died?
3. Were the cattle left in the cornfield continually, or were they fed any grain ration?
4. How long had they been running in the fields before the first death occurred?
5. Have you or your neighbors taken any precautions toward the prevention of this disease? If so, what were they, and what success was met with?

Of the fifty-one letters sent only thirteen replies were received, one stating no outbreaks this year, the other twelve reporting a total of fifty-one outbreaks this year. Clay county reports an outbreak every year since 1884. Burt county has had numerous outbreaks since 1894.

In answer to the second question, as to how many animals died, twelve reported a total of 1,395. From Adams county a loss is reported of 500 head of horses and cattle since 1890. One man from there lost 100 head of horses and cattle. In Burt county fifty head were lost in 1890, and 300 in 1895, mostly cattle. Saunders county lost 200 head last year.

To the third inquiry ten replied that no grain ration had been fed, and that the cattle were in the cornfield continually. One gentleman reports losses among cattle that had access to a haystack.

As to how long the animals had been running in the fields before the first death occurred, the replies show that the time varies from one day to several weeks. But the majority report death during the first few days.

The question concerning prevention was answered in harmony with the reports that have previously come to this department. Eight reported that when the cattle had access to a hay, millet, or straw stack, and were fed a grain ration, the danger of losing stock was not so great. Three advised allowing the animals in the cornfield only a few hours at a time at first. One in particular emphasized the fact that cattle should not be turned into the fields in a starved condition, and that feeders from the range should be fed on a grain ration for a few weeks before being pastured in the cornfield. One gentleman urges to cut their stalks in due time and shred them.

CONCLUSIONS.

From the data gathered from these few letters and from past experience it is known that a great many cattle succumb to this disease. These further show that there is a great difference in the time that animals are in the fields before the first death occurs. It is also clearly shown that the stockmen have found a remedy in feeding a grain ration and not allowing stock to feed on cornstalks alone.

Digitized by Google

HOW TO PRUNE ROSES.

Those who desire to have nice roses in their gardens must know how to prune them. It is a sad sight to the one who loves flowers to pass many a garden and see the ruin brought about by a pruner who did not understand what pruning is for. Roses and shrubs, too, clipped off at the top are seen, and this illustration of the art of pruning is seen in far too many gardens. This is why so many persons get out of heart with their flowers and shrubs; the bad pruning gives them no flowers. The pruning of roses is to be done in spring, and the kind required depends entirely on the class to which the rose belongs. What are called daily roses, which are those that flower all the season, and are composed mainly of Teas, Chinas, Bourbons, and Noisettes, need close pruning. This is why a little freezing does not hurt them, being equivalent to a pruning. The best results are obtained by cutting away fully two-thirds of the wood made the previous year. This causes strong shoots to come out from near the ground, and these are the ones that will give the flowers. For the same reason, viz., that this close cutting back causes good flowers, there is no necessity to cover up these bushes in winter to the extent many do. A spadeful or two of soil piled up about the lower shoots, that, say six inches of the lower part is under it, is sufficient for them. In fact, it is better than too dense a covering. After considering the class of roses mentioned above, the pruning of the remainder comes largely under one general head. Hybrid roses, June roses, and most all the running roses must not be cut down as recommended for the others. Treat them in an exactly opposite way. Prune but little, for these flower from the shoots made the previous season. The long, cane-like shoots are the ones to preserve. When such as the June roses are in good soil they make shoots of from four to six feet in height in a season. These may be topped to advantage, cutting away about a third. A June rose is one that blooms but the once, in June, if we except a few blooms occasionally later on, especially toward fall. These roses are hardier than the everbloomers, and in the middle states need no protection at all. Should such roses be cut down nearly to the ground, away would go the crop of flowers, just as would occur were a last year's raspberry cane treated in that way. Climbing roses are to be treated just the same as June roses. Save the last year's shoots, and you get the flowers. In the South, where many Tea roses become glorious climbers, the treatment must be as for everbloomers. In fact, as already suggested, the habit of the rose will dictate its treatment. If it flowers all summer, it wants close pruning; if but once, but little. Of late years the Russian rose and its varieties, the Multiflora and the Wichuriana, and seedlings from them, have become popular. Of course the proper pruning of these must be decided on in the same way. The best time to prune is in the spring, but not too early. Wait until there is no mistake about the frost having gone. As soon as a rose is pruned its desire is to grow at once, and it must not push out too soon or a late frost may catch it. This advice is for those who do not live far enough south that late frosts need not be feared.

Digitized by Google

CONCERNING GOOSEBERRIES.

No horticulturist should ignore gooseberries, for under good culture they will succeed on a variety of soils, albeit, as in case of the currant, the best results are obtained on a strong, rather moist, well-drained clay loam. As to the cultivation, it should be thorough but shallow. Owing to the fact that they do fairly well in partial shade, says a writer in Ohio *Farmer*, the gooseberry bushes can often be cultivated advantageously between young orchard trees. When set in a regular field, however, they should be located about five feet apart each way, or in rows six feet apart and four or five feet distant in the row. There are several different ways of training them, but, generally speaking, the bush form is by far preferable. As a rule, however, little pruning is required during the first three or four years, except to head back the strong new shoots and remove a few of the less vigorous ones for the purpose of developing fruit spurs all along the canes. In other words, all that is required is to remove superfluous branches and check growth sufficient to keep the bushes within bounds—"civilized," you might say. Like the currant, the gooseberry may be started from cuttings, or by mound layering. By the latter method the old plants are headed back to induce the formation of strong new shoots near the surface of the ground. Then late in June or July, when the new wood has become somewhat hardened, a mound of earth is built about the "stool," the earth being heaped up four or five inches deep above the bases of the shoots. When fall arrives this is removed, the rooted shoots cut off, and planted at once in well prepared soil; or, if preferable, they may be tied in bundles and treated as cuttings, until the following spring. Provided care is exercised in removing the shoots during the winter, however, propagation from the same plants may proceed indefinitely from year to year. In regard to the best varieties, Downing, Smith's Improved, and Pale Red are the most valuable of our natives, the Downing being much superior to the other two in size and quality. There are also some excellent European varieties, most noticeable of which are the Industry and Whitesmith; and were it not for their being so susceptible to mildew, these would be very valuable, in that they have the advantage of a great variety of coloring. As it is, however, one will be on the safest side to use natives only, and especially if he is growing gooseberries for market.

ABSORPTION OF SILO ODOR.

Among the objections raised to silage, and especially the building of silos in dairy barns, is that the silage imparts a flavor to the milk and butter when fed and that the peculiar aroma from the "pit" which is diffused throughout the barn taints the milk while yet in the bucket. A few years ago the Wisconsin Station demonstrated that the feeding of silage a short time before milking imparts a sweetish odor to milk by which it may be distinguished from milk made on a ration in which silage

Digitized by Google

has no part. It was further determined that in the majority of cases if the silage is fed to the cows just after milking, the milk so produced could not be detected by the sense of smell from milk given by cows that had no silage. This sweetish odor was even carried into the butter, so that those familiar with it were able to pick out the samples churned from silage-made milk, but it is interesting and important to note the fact that Chicago experts, says *The Breeders' Gazette*, in scoring these samples, rated the silage-made butter a little higher in flavor. Later work has been done by Professor King and Professor Farrington at the Wisconsin Station to test the influence of the silage odor on sweet milk. A portion of milk was divided into two lots and one was placed in the silo, the can resting on the silage for one hour. These two lots were then distributed into a number of cans and examined by several competent persons to ascertain if the odor of the silage could be detected. Out of 120 examinations more than 10 per cent were incorrect. Again, milk was divided into two portions, one of which was put in the silo for one hour and the other had the air of the silo forced through it for the same time, and in seven out of twenty-four examinations the milk was declared to be free from silage odor, and it was agreed that the odor absorbed by these samples was much less pronounced than that found in milk when silage is fed just before milking. The results of these last tests are very curious, considering the fact that milk is about the readiest absorber of odors of any liquid. Butter shares this property to a large degree. A few years ago a carload of fine butter shipped in a newly-varnished car was found to be badly off flavor when it arrived at its destination, and examination and careful tests made showed that its flavor had been injured by absorbing the odor of the varnish. Butter that came from the old-fashioned "corner grocery store" before the days of refrigerators and careful stock-keeping was wont to bring onto the table a suggestion of the kerosene, the codfish, and the cabbage with which it had been intimately associated in the display of the shopkeeper's wares. As a matter of fact, milk and butter that have come in contact with pungent odors need a clove for their breath about as badly as does one who goes out "to see a man" between the acts of the play, and it is, therefore, remarkable that the milk experimented on with the silo air did not more clearly reveal its close association with that peculiar but not unpleasant aroma.

THE POLLENIZATION OF FRUITS.

HOW THE STAMINATE AND PISTILLATE VARIETIES UNITE TO PRODUCE THE PERFECT SPECIMENS OF FRUIT.

[From a paper read by Prof. B. B. Smyth.]

God's works are wonderful. The problem of life is the greatest mystery with which we have to deal. We never tire of studying the problem whence comes life. The mystery that surrounds the origin of life constantly impels us to explore its hidden chambers.

Digitized by Google

On looking about, we find that all life, both plant and animal, consists of two sexes, male and female. A union of the two sexes is essential to the production of a new life.

Mammals give birth to living young developed from an ovum or egg. A union of the two sexes is necessary in the case of each birth. In the case of pluriparous animals, those giving birth to more than one young at a time, a single union is sufficient for the fertilization of all the ova involved at the one birth.

Birds deposit, one at a time, eggs, incased in a hard shell, to break at a given time later and give birth to living young. A single union of male and female parents is sufficient for the fertilization of many eggs.

In the case of fish, impregnation of the ova takes place outside of the animals and independently of them. The roe and the milt of the several fishes are deposited together in the water, in a suitable place, and union takes place without the further volition of the parents.

One of the strangest of the many strange things in nature is the effort of a salmon (a fish whose maturity is passed in the ocean) to reach suitable spawning ground at the head of long rivers. When the proper season arrives, neither fresh water, nor ice, nor rapids, nor twelve-foot waterfall, nor hunger, nor fatigue, prevents this fish from accomplishing the wonderful task of swimming, perhaps a thousand miles up stream, against every obstacle, going for weeks without food, impelled by an unknown power, for the purpose of depositing in a suitable place the germs of many thousands of its own kind, from which usually but a small number reach full maturity.

Having reached a suitable place at the head of a river, far from molestation by the scavengers of the ocean, the roe fish deposits her burden of spawn, encased in necessary protecting membrane. They may and do repeat the operation until both are practically depleted. That ends their effort. Nature does the rest. Moisture, light, heat, quietude of the water, and electrical conditions have their effect upon the ova. The so-called spermatozoa escape from the milt, penetrate the encasing membrane of the spawn, and, entering the ova, endow them with life. In the meantime the parents, gaunt, haggard, and hungry, are perhaps many miles away down stream on their return to the ocean, which they may or may not have strength to reach.

In the case of most insects, a single union is sufficient for the fertilization of all the eggs that may be laid during life, and, in the case of the aphis and some other insects, a single union is sufficient for many generations. The early aphis, hatched from an egg, gives birth to living young, all females, and viviparous. Several or many generations of this character are thus produced, until at the approach of winter, or an idle season, the colony becomes weakened and gives birth to males. Union now produces eggs that lie dormant until the new season arrives, when the progeny comes forth, all viviparous females, as before. This is termed parthenogenesis.

Digitized by Google

In the case of plants, individual lives may be differently considered. A tree, for instance, may be deemed an aggregate or compound being, and each bud may be considered an individual.

Perpetuation of species may result from either of two methods: (1) Division by separation of leaf-buds, which are sexless, as in grafting an apple, budding a peach, or layering a grape. Separation of tubers, bulbs, corms, runners, etc., are equivalent to separation of buds and reproduce the same kind of plant, with such slight modification as may be owing to climate, soil, or other environing condition or influence. (2) Reproduction by union of reproductive parts, which are sexual. This is called gamogenesis, and might well be used as a title to this paper.

Each flower may be regarded as a house, in which the members are all male, all female, or both male and female. Where the members of a house or flower are all male, the flower is called staminate; where the members are all female, the flower is called pistillate, or fertile; and where flowers comprise both male and female members, the flower is called perfect. The pistil of a flower consists of three parts: the ovary, the style, and the stigma. The ovary is the sack or pocket containing the ova; the style is the stalk, and may be very short, as in the squash, or none at all, as in the pine tree, or many inches in length, as in the silk of the Indian corn; the stigma is the receptive end of the style, though not always the very end, as in the corn, in which the whole side of the exposed portion of the silk is receptive. This silk contains on its sides rows of very short hairs, standing at an angle of about 60 degrees from the silk. These are for the purpose of holding the grains of pollen that fall upon the silk. In the axil of each hair there is a minute pore, through which the pollen finds its way to the interior of the silk, whence it passes down to the ovum at its base. It is known that the contents of a single pollen grain falling upon a silk will find its way down to the ovum, and it is to be presumed that several grains chancing to fall upon the same silk will reinforce each other and reach the ovum quicker. The contents of a single grain, however, are all that is needed to produce the grain of corn. Should no grain of pollen fall upon a silk, or should the silk become cut or broken before receiving a grain of pollen, there will be no grain of cord on the cob at the base of that silk.

Again, a fruit may sometimes be a compound house, or a house of several chambers. The apple is a case in point. In this fruit there are five chambers, each containing four ova capable of being developed into seeds. The stigma of an apple, though apparently simple, is five-fold, and requires at least five grains of pollen, judiciously distributed, for the perfect fertilization of its twenty ova. But, though the pollen is not always well distributed, it usually receives more than that, so that fertilization of an apple does not often fail.

Fertilization of one side of an apple does not necessarily fertilize all sides; but that does not prevent the apple from developing into a full wind apple, though it may, and undoubtedly does, prevent the apple from developing into a largest sized and most perfect apple.

Digitized by Google

In the case of a tomato, a fruit containing five cells separated by partitions, fertilization of one of its cells only causes that side to develop and grow to full size, while the cells which have not received pollen fail to develop, causing the fruit to be one-sided and misshapen. Growth of a cell may be made circumferentially as well as rapidly. For instance, a single cell may take up two-fifths or more of the circumference of the plant, and thus the lack of pollenization of any of its parts may not be well noticed.

Similarly, if one of the three cells of a melon, pumpkin, or other cucurbitaceous fruit were to be prevented by any means from becoming fertilized, the other two cells would fill all the space, crowding two of the walls or partitions close together, with only the undeveloped ova between them.

Mr. Bruce Fink, of Minnesota, has lately performed a number of experiments in pollination of the common tomato, and learned this: that removal of the stigma or a part of the stigma of a flower does not always prevent fertilization, as pollination of the cut portion of the style was quite as effective, owing to the viscous sap, as when pollination is effected in the regular way. He also found, after many experiments, that twelve hours is about the time required for the contents of the pollen grain to pass from the stigma to the ovary. He found another thing: that while usually the offspring of a cross between two varieties was intermediate between the two, it was not always the case; as, for instance, a cross on the Handsomest-and-Best tomato with pollen of the yellow cherry tomato produced a tomato larger and redder than the Handsomest-and-Best. Again, fertilization of the same tomato with pollen of the yellow plum tomato produced fruit flatter than the Handsomest-and-Best, and redder. These experiments, however, are not conclusive, as the fertilization may have been accidental, and may have come about by other pollen than the pollen applied.

When the ovary of a flower is fertilized by pollen from stamens of the same flower it is termed cleistogamy or close fertilization. It is akin to inbreeding in animals. Continued inbreeding in plants, as in animals, has a tendency to weaken the vigor and vitality of the plants.

To offset this, nature provides in many ways for cross-fertilization, or for the reception of pollen from a different house. One of the most obvious of these methods is the separation of the males and females into separate houses on the same plant or tree; and, quite often, separation to separate plants or trees. Such plants or trees depend upon the wind for pollination. Such pollen is not adhesive and does not cling to insects. The stigmas are adhesive and hold all pollen grains that fall upon them. Such flowers are usually inconspicuous, like the elm, box-elder, willow; but occasionally, even rarely, they are quite conspicuous, like the viburnum, or snowball.

In the case of our domestic fruits, which all have perfect flowers, various expedients take place. Among these are: (1) The opening, in all kinds of fruit, of the anther in such manner that at time of opening it is turned upward or even away from the stigma, in such fashion that pollen may be deposited upon the sides of a bee or other insect and carried away to an-

Digitized by Google

other flower; (2) The partial abortion of certain organs, leaving the organs of the opposite sex to develop fully. This is especially true of the strawberry, in which many plants bear female flowers only; and other plants have both sets of organ, but with one or the other more or less imperfectly developed. Varieties differ in these respects. In case a variety happen, like Crescent, or Princess, or Warfield, to be entirely pistillate, it is necessary to plant some varieties carrying stamens, as Captain Jack, Cyclone, or Wilson's Albany, some varieties coming into bloom at the same time, in the patch, to the number of, say one row in three to one in ten in order to have any berries.

Plums are prone, both in our cultivated and wild varieties, to vary in such ways as to prevent self-pollination and to encourage cross-pollination. Stamens in some have long filaments, holding the antlers high above the stigma; in other flowers the reverse is true; the stamens are reduced and ineffective. On account of defective stamens in the plum and cherry and grape in many orchards and vineyards, and on account of inability of some varieties of plums to fertilize themselves, it is not always best, if you happen to have one tree or vine that is a vigorous bloomer but shy bearer, to cut down that tree or vine. That mistake has often been made, to the detriment of the orchard and the discomfiture of the owner.

Another method of preventing self-pollination is the maturity of the organs on different days. This is quite common among all our domestic fruits, especially apple. Usually in the case of the apple, it is the pistil which is first ripe and ready for the reception of pollen. The stamens are still growing and are not ready to discharge their pollen until the next day or day after. By that time the pistil will accept no more pollen, being satisfied.

Our garden fruits are insect loving. Every detail of development in our fruits is for the purpose of inducing insect visits, especially those of bees. Color, form, odor, location of nectary, and methods of reaching it, are all best adapted to bees. It has been noticed that bees, when working on any flowers, visit that kind of flowers only, and do not pass promiscuously from flowers of one species to those of another species or kind. Thus while every effort is made by the flower to induce cross-pollination it rarely happens that circumstances favor hybridization.

The question is often asked why the seed of any particular variety of fruit would not produce the same kind of fruit. The reason is very obvious, The flowers of no one variety can be depended on as having been pollenized from flowers of the same variety, since bees and insects visit all flowers which are agreeable to them, though the bees do not visit them promiscuously. It is a provision of nature that the pollen of any species of plants will only pollenize plants of the same species. When carried to the stigmas of flowers of a different species they remain inert or inactive, but they are active enough in the case of different varieties. When the flowers of any particular variety of fruit receive pollen from some other variety of the same fruit, and the resulting seed is planted, the fruit of the new tree, vine,

Digitized by Google

or bush should partake of the nature in part of both parents. It does not always follow that the resulting product is superior to both of the parent vines, though it sometimes does happen that way; and in this lies the skill or success of the seedsman or pomologist, that he may produce a variety of fruit superior in certain respects to anything else, and out of many trials reject and destroy all which do not reach the standard required by him.

R. M. Kellogg, who raises great crops of small fruits, says: "Plants have their love matches and affinities. They receive pollen from one plant and reject it from another. They give evidence of enjoying the presence of some plants, while others are repulsive. Like the human family, different varieties have decided preferences for certain localities and environment, and one variety will not thrive on a soil deficient in some particular kind of plant food, while another would flourish there grandly." These peculiarities being so, it becomes necessary for the careful horticulturist to study the habits of his plants, their likes and dislikes, for in no other way can he achieve the highest success.

DIVISION OF FORESTRY.

By B. E. Fernow, Chief.

U. S. Department of Agriculture.

Forestry is the art of managing forests or wood crops, using the same rationally, and reproducing them so as to secure continuous supplies. As long as there are extensive virgin forests from which to draw for our enormous requirements of wood material, it appears to many people unnecessary to bestow any care upon the methods of using them. They are cut wastefully, and their reproduction is left to chance and nature's beneficent but slow processes, nature having endless time and infinite space at her disposal and no economic objects to subserve. So it is that, with virgin supplies nearing exhaustion and the forest area becoming more and more limited by the extension of the agricultural area, it becomes apparent that wood crops are not only as necessary as food crops, but that, like food crops, they require some knowledge and care to produce the best results from limited areas, and the need of forestry appears.

Another aspect also becomes apparent with the reckless denudation of mountains and hillsides, namely, the influence of the forest cover upon the soil and water conditions of the agricultural lands below. A new interest in forest condition arises, and again the need of forestry appears.

RELATION OF FORESTRY TO ALL CLASSES OF FARMERS.

Forestry was not practiced in this country when the first attempt was made to have it represented in the department; the Division of Forestry was created in advance of a well-developed interest, and even now the work of the division is still more or less of a missionary character, trying

Digitized by Google

to bring about a reform in our method, or rather in our absence of method, in the use of the forest resources. When the work of the division was begun, only tree planting in the western prairies and plains, as a means of ameliorating the climate, for shade, wind-breaking effects, and for ornament, was practiced; but forestry as applied to existing forests was practically unknown. Here and there a farmer may have cut his wood lot with more or less care, but the majority did not know that their wood lot was capable of being reproduced in superior quality merely by an intelligent use of the ax.

To be sure, the larger portion of our forest resources is not in the hands of the farmers, and hence the larger direct interest in the subject of forestry lies with another class of men, namely, those who control our forest area and the production of our lumber and wood manufactures—industries which rely upon forest growth to the extent of a round half billion dollars for raw material—who employ readily a million workers and produce material worth nearly two billion dollars annually.

This tremendous business of harvesting and transforming our virgin forest crop far outranks all other industries in employment of capital and labor and in value of products except agriculture itself.

While the business of harvesting and using the forest crop in which these industries are engaged is, to be sure, only a part of forestry, yet it is the most important part, for, as stated above, the difference between crude forest exploitation and rational forestry lies in the manner in which the harvesting is performed. Forestry teaches how to cut and utilize the forest crop so as to secure the largest money returns and yet maintain natural reproduction.

It may be argued that the farming community of the plains and prairies, which produces the bulk of our agricultural produce, has comparatively little concern in the question except so far as sheltered-belt planting may be considered a branch of forestry. Yet, even if there existed no direct relation of farming to forestry, such as will presently be shown to exist, the indirect relation must not be underestimated. In these times of close interrelation between all portions of our country and between all pursuits and industries, it would be difficult to find any pursuit or industry or development or condition that does not have a more or less direct bearing upon the farming industry, and hence such a large and far-reaching industry as that which is concerned with the exploitation of our forest resources must have a potent interest for the farmer.

Paradoxical as it may appear, for instance, the farmer in the forestless region is in one direction more concerned in the fate of our forests than his brethren in the forested states. For these have stone, iron, and coal ready at hand as substitutes for the wood material, while the development of the plains and prairies has been possible only by means of cheap and easily transported building material. When prices for wood material rise, owing to the rapid decimation of our virgin supplies, which is now appreciable, the first one to feel the difference will be the farmer on the prairie.

Digitized by Google

FORESTRY KNOWLEDGE NECESSARY FOR THE FARMER.

But the forestry business has a much more direct and intimate relation to the farming industry in the forested than in the forestless regions. Having to deal with crops of the soil, the farmer in these regions must divide the soil with the forester. If he be the owner of land not all fit for the plow, he must know what portions to leave to wood crops and which to devote to farm crops. He must then learn to manage his wood crops as well as his food crops, and thus a direct need for forestry knowledge by the farmer arises.

In deciding upon the allotment of lands for forest and farm purposes, the fact that wood may be grown successfully in soils and situations which are not adapted for farming forms the primary basis; yet, other considerations must also enter into this determination. The farmer not only manages the soil, but he must also manage the water resources and climatic conditions so far as he is able, although he has hitherto but imperfectly realized the possibility, importance, and methods of such management.

FOREST INFLUENCES.

There is a well-substantiated belief that a forest cover exercises certain influences not only upon the soil on which it stands and on the waterflow and climatic conditions within its own boundaries, but beyond these; hence the existence or absence of a forest cover, its presence in situations where a beneficial influence upon surrounding conditions may be exercised, its treatment so as most effectually to secure its protective influences—all these considerations are of direct concern to successful farming.

This question of forest influences has been again and again discussed in annual reports, but most exhaustively in Bulletin No. 7 of the division, "Forest Influences," published in 1893. This publication enables the farmer to form his own opinion as to the character and degree of influence which a forest cover exercises upon the wastage of his water resources, upon the erosion and silting of his fields, and upon the loss in his crops from winds and other causes which may be affected by the forest cover; and thus he may be enabled to decide judiciously as to what portion of the farm to leave in woodland.

Water Management.

To bring the application of this knowledge more fully to the farmer's conception, the loss which our farming lands suffer annually by erosion, amounting to millions of dollars of soil capital, is graphically depicted in a colored chart, designed to be exhibited as an object lesson in schools, post-offices, and other public places. It shows how the denuding of the hilltops and the compacting of the soil by the rains and by the trampling of cattle induce rapid surface drainage. The compacted soil is gullied and washed away, the valley fields silted, and the farm is lost. The chart also shows how by keeping hilltops and steep slopes under forest, by filling gullies with brush and stonework, and providing for underground drainage, etc., the farm is regained, and how by judicious distribution and manage-

Digitized by Google

ment of forest cover and proper assignment of soil to various purposes the farm is retained in best producing capacity. This relation of forest to farms has also been discussed and illustrated in Farmers' Bulletin No. 20, "Washed soils: How to prevent and reclaim them," and in the Yearbook for 1895. Water management (meaning thereby not only the use of water for irrigation in the arid and subarid regions, but the rational distribution and use in the humid regions of available water supplies) is the great problem of the future, upon the solution of which more productive agriculture depends; and with the solution of this problem the forestry problem is most intimately connected, for without forest management no rational water management is possible.

Relation of Forests to Surrounding Conditions.

As this is perhaps the most important direct relation of the farmer to forestry and there are still erroneous notions as to the philosophy, character, and degree of this relation abroad, we may be allowed to briefly state what our present knowledge regarding it seems to be, referring the reader for a fuller discussion to the publication cited above.

There are two questions involved, namely, the effect of a forest cover on the conditions within its own boundaries and on the conditions of adjoining territory. That the degree of influence depends largely on the kind and condition of the forest growth itself must be self-evident; it must differ according to the composition (hardwoods or conifers), the density (open or close stand), the height or age of the trees, and many other conditions.

The influence upon the conditions under its own cover are mainly due to the mechanical barrier which the canopy of foliage interposes between the sun, the rain, the winds, and the air of the interior and the soil. The exclusion of sun and wind reduces the evaporation, and hence both the air and soil under the shade of a forest cover should, as a rule, be not only cooler, but moister than in an open or barren field. Trees, to be sure, require water for their growth, but it seems that they require less than a growing field or grass crop or weeds, and, since they bring up the water from greater depths and transpire the greater part into the air, they increase the humidity of the air in their neighborhood.

Yet, it is still an open question whether forests contribute to an increased rainfall in their neighborhood. Other conditions producing rainfall are so much more powerful that it is doubtful whether this forest effect, if it exists, would be appreciable even within a restricted area. On the other hand, it is well known that a timber belt or even a few rows of trees in a wind-break or shelter belt have not only a beneficial effect on orchards and cattle, especially in the open prairies and plains, but also on crops in adjoining fields; because, by breaking the force and velocity of droughty winds, the evaporation is reduced, and hence more moisture remains for the use of the crops.

The most patent and most potent effect of forest cover upon water and soil conditions is to be found in a hilly or mountainous country. Again, this effect is a mechanical one. Crops depend less on rainfall than on

Digitized by Google

water supplied to their roots, however obtained, whether it be furnished by rain direct, by artificial surface irrigation, or by natural underground irrigation. Rain is not the most desirable form in which our water supply comes to us, as the districts relying on irrigation testify. The ideal form of supply is by natural underground drainage.

Now this is precisely what a forest cover, on the higher levels as well as in the valleys, aids in securing, namely, the changing of surface drainage into subdrainage, and the conservation of moisture against dissipation by the evaporative influence of sun and wind. A forest growth keeps the soil porous, and with its deep-reaching root systems assists the percolation of the falling waters or melting snows, and permits subdrainage of these waters, which prevents their wastage by surface evaporation; while on a bared slope and even in a cultivated field the pattering raindrops compact the soil, thus finally by their own action impeding percolation. As a consequence, less water penetrates and more is finally evaporated by capillary action, and hence less remains available for the crops at lower levels. The waters falling on a well-forested slope find the lower levels underground and furnish the desirable constant supplies to the lowland fields. This explains the constancy and even flow of springs and brooks in a well-wooded country, where uneven flow, floods, and droughts become frequent after denudation.

Between the extreme conditions of an absolutely bare slope and a well-wooded one there may be many gradations, and the condition of the forest cover will necessarily determine the amount of influence it exerts. Besides, geologic formation and topographic contour must be considered. There may be loose rocks and gravels, which, without a protecting forest cover, remain readily permeable, and again there may be such precipitous slopes that even a forest cover cannot much impede the surface drainage.

In addition, the rapid surface drainage on a thinly forested or bare slope induces the gullying and eroding process, and the destruction and wastage of fertile soils at lower levels is the consequence. The character and degree of this erosion, to be sure, varies according to the character of the soil and the slope. There may be conditions where no danger need be feared from this source, but over large areas in our countries there are just such conditions, as in France, where whole communities have been impoverished and large areas depopulated by erosions and floods, induced by forest devastation on the slopes. In such localities, at least, it is essential that the farmer exercise judgment in the location of his fields, as well as in the management of his woodlands.

The loss of soil capital in the United States, due to this cause, has been roughly estimated at 200 square miles of soil per annum. The great floods of the Mississippi and the hardships to agriculture resulting therefrom, are intimately bound up with the condition at the headwaters of streams and along stream banks, and may, in time, be avoided, or at least reduced in frequency and danger, by a judicious management of the drainage conditions which furnish the flood waters. Forestry, as Captain Eads himself foresaw, will have to come to the aid of the engineer.

Digitized by Google

From these statements it will appear that not merely as a citizen interested in the general welfare of the country is the farmer under obligation to take interest in the subject of forestry—if not in its technical aspects, then at least in its importance with reference to other economic conditions—but as one whose own industry and capital are directly influenced by forest conditions.

SYLVICULTURE.

For those who desire to get a general conception of the objects as well as the methods of forestry as practiced abroad, there is, besides the annual reports which discuss various phases of the subject, a brief, yet comprehensive, discussion to be found in Bulletin No. 5, entitled "What is Forestry," of which a large edition has been published and distributed.

For those who desire more technical information and wish to apply some of the forestry principles to the treatment of their wood lot, the Yearbook for 1894 in the paper "Forestry for Farmers" gives concise instructions, elucidating first the manner in which trees and forests develop and then giving hints as to how the wood lot should be cut systematically to secure a young growth of desirable species.

Under the caption of "Tree Planting in Waste Places on the Farm," the Yearbook of 1896 gives, at least, valuable hints as to how the untillable ground, the rocky and unsightly spots of the farm, may be made useful by devoting them to tree growth.

It is only possible in such brief papers to give general principles, since the flora, the climate, and other conditions vary to such an extent over our large country that specific rules could be formulated only for a definite locality. When it comes to the practice, the farmer will have to study his own conditions and apply the principles according to his own judgment and experience, just as in other agricultural problems. Furthermore, much of the specific knowledge which would entitle us to give authoritative advice is still lacking.

FOREST BIOLOGY.

In order to manage a forest growth intelligently we must know first of all the biology, or life history, of all the kinds of trees which compose it, what conditions they require for their best development, how their growth progresses from the seed to maturity, especially their relative height growth, and their light requirement or shade endurance, for this knowledge alone will enable us to judge whether and how we can maintain the desired composition and secure its best development and reproduction.

The European forester needs this knowledge only for six or eight species, while the American forester in almost any part of the country must be familiar with the requirements of at least a dozen or two; and he who would want to give specific advice for all parts of our country must know the life history of at least 100 tree species out of the 450 which are found native in the United States. He must, in the first place, know to which of the host of tree forms to direct his attention; he must determine which

Digitized by Google

are to be considered economically valuable species, which have only subordinate sylvicultural value, and which must be considered simply as weeds (for there are weeds among trees as well as among other plants). But weeds, we must not forget, are only plants, the use of which is not yet known. He must, therefore, classify the trees as to their relative value, and for such classification he must have sylvicultural, biological, and technical knowledge of them.

Nomenclature.

It may be well to remind the reader that in the development of any science or art there is much work necessary to be done that has apparently no direct practical value. Yet, to insure the satisfactory progress of such development, it has to be done, and sometimes the practical value will show when least expected. Of such a class of work is the revision of the nomenclature of the arborescent flora, which was published in Bulletin No. 14—an attempt to bring about uniformity in the use of the botanical as well as of the vernacular names. It was a very practical question which suggested the urgent need of this work, namely, the loss of money by a firm of nurserymen, who, in ignorance of the different use of names by the customer, supplied the wrong plants. Again and again has the confusion of names led to similar troubles.

Biological Work of the Division.

The work of the Division of Forestry in a biological direction has been progressing very slowly, partly because of a lack of men fitted to pursue this particular line of work, which requires a certain amount of forestry education and close observation in the field, and partly because of scant appropriations.

A first attempt at a tentative classification of our forest flora was made in the annual report for 1886, in which a list of 97 species then conceived as of economic importance was given, classified according to their relative value, with notes regarding their sylvicultural requirements.

More comprehensive studies were made regarding the most important timbers of the eastern United States, the conifers (spruces, pines, hemlock, cedars, cypress), which, although perhaps of less direct interest to the farmer than the broad-leafed trees that usually compose his wood lot, at least in the northeastern section of the country, furnish from two-thirds to three-fourths of our enormous lumber consumption, and their reproduction is, therefore, of the greatest interest to the people at large and to the forester of the future.

So far, the division has been able to make a thorough study of five species only with sufficient completeness to warrant the publication of results, namely, the white pine, the monograph on which is to be published shortly, and the four southern lumber pines, which were discussed in Bulletin No. 13, "The Timber Pines of the Southern United States," published in 1896.

Although these studies are designed more particularly to meet the needs

Digitized by Google

of that class of men who control the pine forests, and to assist them in a better management of the same, every farmer who wishes to widen his conception of the drift and importance of the subject should read Bulletin No. 13. It is the first attempt in the United States of a comprehensive statement, from a forestry point of view, of the economic, technical, and sylvicultural conditions and requirements of four species of forest trees

A knowledge of the life history of the species composing the forest and of their sylvicultural requirements is all that is necessary to manage the crop for the best development and reproduction. This part of forestry—the growing of the crop—is designated as sylviculture. But the forester whose business it is not only to grow the crop, but to market it and produce a money result, must have knowledge in three other directions, namely, he must know how fast his crop develops, he must know for what purpose the different parts of his crop can be most profitably employed, and, lastly, he must have some knowledge of market conditions and market requirements.

FOREST MEASUREMENT AND FINANCE.

The forest crop differs from all other crops and forestry differs from all other industries of production in two ways. There is no definite period when the crop can be said to be mature, as in the case of agricultural products; it consists, first, of annual accumulations which are allowed to continue until the individual trees attain either a useful or a profitable size; and, secondly, to attain such size a long time, and, with different species and conditions, a variable time, is needed; thus, for firewood production a growth of fifteen to twenty-five years might suffice, while for good lumber production not less than seventy-five to one hundred years and more are needed. This indefiniteness of the time of maturity and the unusually long period of production during which the crop has to grow predicate peculiar business arrangements, entirely different from those prevailing in other industries, if forest growing is to be carried on as a financial business, and so necessitate to a greater extent than with any other a full knowledge of the forest industry.

Tree measurements, especially measurements of the rate of growth of single trees and of whole stands of trees, furnish the basis for determining the first question, namely, when under given conditions the useful or the profitable sizes may be expected to be attained.

The division has, therefore, for some time, as opportunity has been afforded, carried on measurements of the rate of growth of certain species, especially of the important conifers. It is now in position to make a comprehensive statement of the growth of white pine, having analyzed nearly 700 trees from many localities, the results of which will permit an estimate of the possible yields that can be expected from this species at different periods of its life. This is a much more complicated matter than most people would suspect, especially since our measurements can only be made on trees and stands of trees which have grown in nature's unattended forests, while with the application of knowledge and skill in the

Digitized by Google

management of the crop quite different results may be secured. Bulletins of this division will shortly be published on the measurement of standing trees and forests and on the measurement of the rate of growth of trees and forests.

There have been many misconceptions abroad as to the rapidity of tree growth and the amounts that may be harvested from an acre in a given time. If wood alone were to be produced, the matter would be much more simple. We could, from the experience which has been gathered in other countries and in our own, soon arrive at a statement as to the amount of wood which an acre of a full-grown dense forest crop could produce, just as we know the productive capacity of an acre of wheat or barley.

In an average of a hundred years the yearly growth, according to species, soil, and climatic conditions, would vary between 30 and 180 cubic feet of wood per acre each year. But, unless firewood is the object of forest cropping, it is not quantity of wood merely, but wood of given size and of given quality, wood fit for the arts, that is to be grown. Such wood alone it will pay to raise. Hence, it is necessary not only to know what sizes can be grown in given periods of the life of the crop and what sizes can be profitably handled at the mill or in the market, but also what qualities are desired and under what conditions they can be produced. Trees develop very differently at different periods of their life. Thus, while a white-pine tree may in the first fifty years have grown on an average one-third of a cubic foot of wood per year, if we had waited till the hundredth year the average rate per year would appear as more than 1 cubic foot, and the total volume four to five times what it was at fifty years, although the diameter has only about doubled. Again, while at fifty years hardly more than 15 per cent of the total wood volume would have furnished saw timber, perhaps making 50 feet B. M., at one hundred years the proportion of the more valuable milling material would have risen to 40 per cent and more of the whole tree, and the output of timber has reached 500 feet B. M. On the other hand, an acre of pine fully stocked which at one hundred years may have produced at the rate of 140 cubic feet per year could under the same conditions have produced for the first fifty years at the rate of 180 cubic feet per year, or nearly one-third more. Yet, the value of the wood and that same acre at one hundred years is very considerably more than the fifty-year old wood, on account of the increased proportion of highly useful material that can be got from it. Similarly, we find that not more than 1 to 2 per cent of the wood produced in the coppice woods of twenty to twenty-five years' growth, in which New England abounds, is serviceable in the arts, while 50 to 75 per cent and more may be thus profitably utilized from the same acre if allowed to grow one hundred years.

It will readily be seen from these few glimpses into the subject that this knowledge of the rate of development and yield of our timber trees is indispensable for the discussion of the profits of forest cropping, and also furnishes hints for rational methods of sylviculture. This same white-pine tree, for instance, could have made much more wood if it had been al-

Digitized by Google

lowed to grow without interfering neighbors, but it would not only have assumed less useful, conical shape, but would have put much of its energy into branches, which not only do not furnish serviceable wood, but produce knotty lumber, an inferior or unsalable article. Moreover, the wood of most or many of our trees changes in quality with age, so that with size, form, and freedom from knots, not only the technical value, but the money value also, grows disproportionately.

CONSUMPTION AND WASTE WOOD.

Regarding the technical value of our woods the ignorance of our people, even of those whose business it is to use wood in structures and otherwise, is so great that an enormous waste of good material is the result. Our nation has used and is now using more wood materials than any nation ever did, our wood consumption per capita outside of firewood being eight to ten times that of Germany and eighteen to twenty times that of Great Britain. Not only do we rely more on wooden structures, but we are more wasteful in their construction. This waste is induced by two causes—ignorance regarding our supplies, which we seem to believe inexhaustible, and ignorance regarding the properties of our timber and of wood in general, which results in wasteful lavishness.

In the opinion of the writer, change in our methods of using wood has become an absolute necessity, for if we persist in the wasteful squandering of our virgin supplies of timber we must inevitably exhaust them before a new crop is ready to supply even our more limited necessities. The farmer should be as much interested in this question as any other class of citizens, and perhaps more, for he relies upon wood more than any other class, not only in his buildings but in his implements.

STATISTICS.

The division has never been placed in position to ascertain with any degree of accuracy the question of supplies, but has gathered at least such information as was accessible from other sources, and has endeavored to present them in such a manner as to attract attention to the gravity of the situation.

In Circular No. 11, "Facts and Figures Regarding our Forest Resources Briefly Stated," it was estimated that at the very best there were to meet our annual consumption of a round 40,000,000,000 feet B. M., in bolt and log size, not more than 2,300,000,000 feet of timber standing, or less than sixty years' supply. This is probably a very sanguine position, and does not take into account that much of this timber is certain to be cut into firewood or burned in our annual conflagrations.

The situation is still less assuring when we confine the inquiry to the coniferous growth, which, as we have stated, furnishes at present nearly three-quarters of our lumber consumption. This was discussed in a report in answer to a resolution of the United States Senate of April 14, 1897 (Senate Doc. No. 40, Fifty-fifth Congress, first session). In this report it was shown that there was probably not sixteen years' supply standing in

Digitized by Google

the eastern states if we continue to cut and waste it as hitherto, and that the supply of the Pacific coast would not suffice to lengthen this period of plenty beyond thirty years, even if this supply were not largely destroyed by fire.

The lesson to be learned from these statistical inquiries is that the time when supply in excess of demand has passed, considering that to grow a really serviceable mill log of pine requires not less than 100 years—the trees that have hitherto been considered serviceable for such purposes being much older. Farmers who own really good saw timber will do well not to fritter it away, but carefully cut it, when salable at good price, in such a manner as to reproduce the crop.

FOREST TECHNOLOGY AND TIMBER PHYSICS.

The other element of ignorance which leads to waste, namely, the properties of wood in general and of our timbers in particular, acts detrimentally in two ways: first, by not knowing or appreciating the value of many of our woods, we fail to use them, and waste the supply in logging operations; and, second, by not knowing more exactly the properties of those we use, we apply them in wrong places and wastefully. Everybody knows how the black walnut has been squandered in fence rails and been burned without the knowledge that it could have been kept for a century (in logs, if not standing), with increase in value and without danger of decay. Who does not remember how millions of feet of hemlock, from which the bark was taken, were lying rotting in the woods, because the value of the wood was unappreciated. And even to-day millions of feet of most valuable chestnut and oak are left in the woods unused after the bark has been taken by the tanner. While this may be in part due to economic conditions, the transport of the wood being too difficult and too expensive, there is no such reason for leaving the excellent hemlock of the Pacific coast uncut in the woods.

In some portions of Washington and Oregon about one-half the forest growth consists of hemlock trees 300 feet and more in height and three to four feet in diameter, furnishing a magnificent material for many purposes. Yet, such is the ignorance regarding its value that it cannot be marketed, and it is left standing. This would at first sight appear an advantage for the future; but it is not, for the trees, suddenly placed in different conditions, even if the fires that follow the logger should spare them, die as the consequence of the exposure by removal of their neighbors, and thus one-half the value of the forest growth is lost. Examples of this kind could be multiplied from all sections of the country. The other kind of ignorance, namely, regarding the properties of the woods which we do use, exhibits itself in their wrong and wasteful application.

There has been so little systematic and reliable investigation on our timbers that until a short while ago the sizes which architects, builders, and engineers prescribed for use in structures were formulated upon the data furnished by European investigators on European timbers, which are by no means of the same quality as ours. The use of unsuitable woods in

Digitized by Google

places where liable to decay, and the absence of proper handling of woods used for such purposes, occasion a large wastage, due to the necessity of replacing them; and many a disaster, from the break of a wagon pole to the collapse of a building, in which large amounts of property and even life are destroyed, may be traced to ignorance in the use of woods.

The first statement as to the wasteful use of our timbers we can substantiate by the investigations of the division, which have shown that the strength of our long-leaf pine is from 20 to 25 per cent greater than had hitherto been supposed; by this knowledge an annual saving of at least $6,000,000 worth of this material alone could be effected. The demonstration by the division that the bleeding of this same species for turpentine does not deteriorate the timber value of the trees has added at least $2,000,000 annually to the products of the pineries of the South.

A few years ago the division inaugurated a most comprehensive investigation, such as had never been attempted elsewhere, in order to remove, once for all, ignorance so fatal to a conservative use of our forest resources. The plan elicited the commendation of both European and American engineers and wood consumers in general, who realized most readily how little we know of wood and how important such knowledge is, and how dangerous in its consequences is the absence of reliable information. The results, being capable of immediate application in practice, promised more immediate effects in the direction of more conservative use of our forest resources than any other line of work. Yet, through lack of appreciation of its direct influence upon the forestry problems of the country and deficient appropriations, the plan was curtailed in its scope, and has finally been abandoned.

This work and the publications that have resulted therefrom so far may not be of direct and special interest to the farmer, as they are necessarily in the first place designed for use of architects, engineers, and others using wood on a large scale. Yet, even though the farmer's interest in the subject is seemingly limited, it may be well worth his while to become familiar with two of the publications emanating from these investigations, namely, Bulletin No. 10, "An Elementary Discussion of the Characteristics and Properties of Wood," which attempts to give in concise form what general knowledge we have regarding wood, with such examples of our own timbers as were available, and the paper in the Yearbook for 1896 on "The Use of Wood," in which the principles are discussed which should guide in the choice of our woods for various purposes. From the final results of these investigations, if they should be continued, the farmer would indirectly benefit as much as every other citizen who builds a house or uses a spade.

Those engaged in growing wood for profit will recall what has been said regarding the profitableness of forest culture as depending on our knowledge of the qualities of our product and its serviceableness for different purposes, and will readily form an opinion as to the paramount need of these investigations, which can in a comparatively short time be brought to conclusion.

We repeat, that, as far as the enormous business of harvesting and

Digitized by Google

marketing forest products and of wood manufactures is concerned, the forestry interests lie in the hands of other men than the farmers, who own only a limited portion of the great forest areas.

TREE PLANTING IN FORESTLESS REGIONS.

Forests grow in humid regions; and as forestry has to do with forests rather than trees merely, as the etymology of the word indicates, the work of the division has had most concern with the interests of these regions instead of making the tree planting in the western states its most prominent concern. Nevertheless, the beneficial influence which tree growth may exercise on surroundings being first realized when the absence of it suggested it to the settler on the open prairies and plains, tree planting became early a practice among the settlers in those regions.

This tree planting had in view protection from cold and hot winds, shade, and shelter rather than wood supplies, and we may as well recognize at once the fact that while undoubtedly this beneficial influence of timber belts may be secured in most parts of the arid and subarid belts, and incidentally the supplying of firewood and other timber of small dimensions for domestic use, it is entirely out of the question to expect that these plantings will ever furnish supplies for our great lumber market. These supplies will always, the writer believes, be grown in the regions in which forests now grow and which are by nature best adapted to wood crops. Nevertheless, the division has given attention to the needs of the tree planter in the prairies and plains, who is concerned in the artificial creation of forest growth to ameliorate his climatic conditions.

In these arid and subarid regions, where nature has denied tree growth, the climatic conditions are so different from those of the humid parts that not only different methods of cultivation are necessary, but the plant material must be imported and selected with a view to a rigorous climate, characterized by extreme ranges of temperature. A range of 50 degrees below zero to 120 degrees F. above must be endured by the trees, their moisture requirements must be of the smallest, and they must be capable of responding to the enormous demands of evaporation. At first, whatever trees will grow successfully from the start under such untoward conditions would have to be chosen, no matter what their usefulness otherwise might be.

The first settlers have ascertained by trials some of the species that will succeed under such conditions, but unfortunately most of these are of but small economic value, and some of them are only short-lived under the conditions in which they have to grow. The methods of planting were naturally suggested by the experience of orchardists and nurserymen, since forest planting had never been practiced in this country, but unquestionably many failures can be avoided by application of forestry principles in these plantings. Whether more useful kinds can be found that may be grown to advantage, and whether methods of planting can be devised by which a greater efficiency of the plantation may be gained, are problems which the division has taken up within the last few years.

Digitized by Google

Such problems can, of course, only be solved by actual field work, experiment, or trial, and hence the co-operation of the state agricultural experiment stations has been secured to carry on such experiments. The station authorities have placed some land at the disposal of the department, and the professor of horticulture or some other officer of the station superintends, free of charge, the labor of planting, cultivating, etc., while the Division of Forestry furnishes the plans, plant material, and all expenses.

So far the stations of Montana, Utah, Colorado, Texas, Oklahoma, Kansas, Nebraska, South Dakota, and Minnestota are engaged in this cooperative work. In addition, there are two planting stations located in the forested regions, namely, one in Minnesota and one in Pennsylvania, to experiment on practical methods of reforesting cut-over waste brush lands.

Some few years ago the writer came to the conclusion that the conifers, especially the pines, would furnish more useful and otherwise serviceable plant material for the arid regions. Not only are they of greater economic value than most of the deciduous trees that have been planted, but, requiring less moisture for their existence, they would, if once established, persist more readily through droughty seasons and be longer lived; besides, their persistent foliage would give more shelter all the year round.

A small trial plantation on the sandhills of Nebraska, described in the annual reports of the division for 1891, lent countenance to this theory. To be sure, the difficulty of establishing the young plants in the first place is infinitely greater than would be experienced with most deciduous trees. A large amount of attention was, therefore, devoted to finding practicable methods of growing the seedlings cheaply for extensive use and of protecting them for the first years in the plantations, for the transplanting of conifers is attended with considerable difficulties, especially in a dry climate, and they require in the first years protection from the sun and winds. They must, therefore, be planted in mixture with "nurse" trees which furnish not too much and yet enough shade. It cannot be said that the success in using these species has so far been very encouraging; nevertheless, the failures may be charged rather to our lack of knowledge and to causes which can be overcome than to any inherent incapacity of the species. The experimentations should, therefore, be persistently continued.

Mixed planting and close planting are undoubtedly the proper methods of establishing quickly forest conditions, when without further attention the plantation will take care of itself. But it is essential to know what species should be planted together and how close in order to secure the best results, and this knowledge can only come from experience and actual trial, since the behavior of trees in regions in which they are not indigenous cannot be predicted by anyone.

Digitized by Google

SEED EXCHANGE.

There is one other cause of failure which has rarely been suspected, and which it is most difficult with the present practices of nurserymen and seed dealers to overcome.

It has generally been known that the hardiness of a plant, its capacity for withstanding cold and drought, is dependent on what it has been accustomed to endure in its native habitat. The seed and the plant originating from that seed possess no more hardiness than the parent plant. It is, therefore, essential, when attempting to introduce plants into climates in which they are not indigenous, to secure them from climates as nearly as possible like the one into which they are to be introduced. With annuals, this is perhaps less essential than with trees which are expected to persist all the year for many years. Yet, no care has been taken in this respect. We transplant acorns, or oak seedlings, from the warm, moist climate of Pennsylvania into the dry, cold climate of the Dakotas, or we use the seed of the Douglas Spruce from the moist, even-tempered Pacific Coast instead of from the dry, rigorous climate of Colorado, and no wonder the planting is a failure.

To demonstrate that this is so, and at the same time to ascertain how far this adaptation to climatic conditions extends, a seed exchange experiment has been instituted, in which a large number of the agricultural experiment stations have kindly consented to participate. Seeds of the same species are collected at the various stations and are exchanged between the stations, so that at each station the same species from all localities is grown simultaneously. No more striking illustration could be had of the truth of the law as stated than the rows of box elder and ash at the station at Grand Rapids, Minn; those from seed gathered in Ontario, fully germinated, 30 inches high the first year, vigorous and entirely unaffected by the first September frost; by their side are the rows grown from seed gathered in Oklahoma, a thin stand, half the height of their neighbors, poorly developed, and the foliage completely collapsed by the slight fall frost.

The conclusion is, that unless we control the collection of the seed from most northern and driest points, where the species grows, we have neglected a most essential element of success in the effort of acclimatization.

PLANT INTRODUCTION.

This work of introducing and bringing to trial new and untried species has been lately extended to exotic species in addition to our native ones. It is proposed to systematically collect all the trees and shrubs which exist in the arid and subarid region of the world into arboreta, or trial grounds, located in different parts of our own arid belts, where they can be studied and observed, and where finally those can be selected which promise the best results for planting under those untoward conditions. Such systematic effort, carried on with persistency and circumspection, must, it would seem, lead to the discovery of new and valuable additions to our economic flora.

Digitized by Google

It stands to reason that if this is desirable for the regions which are poorly endowed with native forms, it is not less desirable for more favored localities, and if the systematic procedure is preferable to the haphazard sparodic attempts, with regard to the introduction of tree growth, it is equally preferable in the introduction of other economic plants. It is, therefore, to be hoped that this work of plant acclimatization will be extended to all kinds of plants with liberal appropriations from Congress, when the Division of Forestry will have the satisfaction of having assisted the farmer by having taken the lead in this work, though in a direction not exclusively its own.

PROPAGANDA.

Besides attention to technical work, a large amount of time and effort has been spent by the members of the division in and out of office hours in forwarding the movement for a more rational treatment of our forest areas. Many lectures before farmers' institutes and elsewhere, articles in newspapers and technical journals, and official circulars of information have been the result.

Thus, in Circular No. 1, addressed to teachers in public schools, it was tried to enlist them in the movement. Circular No. 10 gives suggestions to lumbermen how to secure their property against fire; Circular No. 11 attempts by a succinct statement of facts and figures regarding our forest resources and wood consumption to arouse interest in the subject; Circular No. 13 gives a synopsis of the more recent laws against forest fires, most of which were, in part at least, formulated in the division, and Circular No. 17 gives a synopsis of other legislation on behalf of forestry in the states, also largely formulated in consultation with the division.

FOREST RESERVATIONS.

The condition of the public timber lands naturally occupied the attention of the division from an early time. A full report on the condition of the forests in the Rocky Mountain States was presented in Bulletin No. 2, published in 1887, and in the same year the writer formulated a comprehensive bill, with report, providing for a rational and profitable administration of the same. This bill, introduced in Congress, afterward known as the Paddock bill, did not become a law, but its educational effect and its frequent discussion before the committees on Public Lands led finally to the passage of a law empowering the President to set aside forest reservations from the public domain. After some 18,000,000 acres had under this law been so reserved, the necessity for their protection and administration was persistently urged, and finally this year, besides an increase in reservations, legislation attempting to provide for such administration has been secured.

The reservations being located in the mountain districts of the western states, where farming is largely dependent upon irrigation by means of the waters collected in the mountains, there is naturally a very close, though indirect, relation of the farming interests to the condition of these forest areas.

Digitized by Google

The destruction by fire, ax, and indiscriminate pasturing of these mountain forests without reproduction or reforesting must ultimately lead to even worse damage to agricultural interests than has been experienced in France from similar maltreatment of the mountain forests. Where the farmer relies upon irrigation he will suffer from uneven distribution, excess, and deficiency of water supplies, and, with the mountain slopes bared, floods and droughts will be aggravated and the fertile lands below gullied, washed, and silted.

While at present these public reservations are under the Department of the Interior, in the General Land Office, such close and important relation between agricultural interests and forest conditions suggests as a logical proposition the ultimate transfer of these reservations and their administration to the Department of Agriculture, which is charged with the cultural interests of the country, and to which the technical problems involved in such administration have already been referred by the creation of the Division of Forestry. When such transfer is effected, not only will the Department of Agriculture, and with it the farming community, gain in prestige, but the farming and forestry interests by being under the same administrative head will find increased relation to each other.

FERTILIZER INDUSTRY.

While in Nebraska we are not to date as much interested in the fertilizer problem as in older states having more depreciated soils, it is well to understand it in advance. To this end we give place to an official report by John Hyde, Statistician for the U. S. Department of Agriculture, Washington, D. C.

The total consumption of fertilizers, by states and for a series of years, more or less complete, from 1891 to 1897, is shown in Table 1, and the value of these fertilizers in Table 2.

It is to be understood that only commercial fertilizers are included in these tables, or in any of the tables of this report.

QUANTITY.

Only one year (1896) is complete for all states, and during that year 1,894,917 tons of fertilizer were consumed, valued at the factory at $37,688,-869, which is considerably less than the amount paid by farmers.

Georgia is by far the principal user of fertilizer among the states, the quantity used in that state in 1896 being 335,618 tons. South Carolina stands second, with 199,497 tons; North Carolina third, with 187,429 tons; Virginia fourth, with 171,704 tons; New York and Pennsylvania fifth and sixth, each with 150,000 tons, approximately; and Alabama seventh, with an approximate consumption of 100,000 tons.

VALUE.

With respect to the values of the amounts consumed these states do not stand in the same order. Georgia still leads with a value of $4,698,652; but

Digitized by Google

New York is second, with $4,691,500; Virginia is third, with $4,034,944; Pennsylvania is fourth, with $3,750,000; North Carolina is fifth, with $2,811,435; and South Carolina is sixth, with $2,792,958. Alabama, although consuming a larger amount of fertilizer than New Jersey, and probably Maryland also, is below both of these states in the value of the fertilizers consumed, and is but little above the state of Ohio in this respect.

It is observable that in 1895 the farmers of the South, owing probably to financial depression and the low prices of farm products, reduced their expenditure for fertilizers, but there was an increase in 1896 and a further considerable increase in 1897. The fertilizers used in the South are cheaper than those used in the North, chiefly because the South uses more phosphates, which are a local product.

Statistics of the consumption of fertilizers have been published in reports of two censuses, those of 1880 and 1890, but these statistics disclose only the value of the fertilizers consumed. It may be found that for certain states the values given in Table 2 for 1896 are less than those given in the census of 1890, but it does not necessarily follow from this that there was a smaller consumption of fertilizers in 1896 than at the census of 1890, because the factory value of fertilizers has been a declining one since the former year, and furthermore the census values are retailers' values.

TABLE 1.—TONS OF COMMERCIAL FERTILIZERS CONSUMED IN THE UNITED STATES, BY STATES, 1891 TO 1897.

[Tons of 2,000 pounds.]

STATES.	1891.	1892.	1893.	1894.	1895.	1896.	1897, to Oct. 1.
Vermont	9000	9500	10000	11000	12000	13000	14000
Connecticut	.....	.....	.....	22500	.....	20000	.....
New York	.....	90333	.....	.....	.....	150000	.....
New Jersey	43414	47654	51758	53469	51149	56355	.....
Pennsylvania	.....	128000	150000	150000	150000	150000	150000
Virginia	114119	142826	152082	156582	156700	171704	.....
North Carolina	150000	104178	145466	131243	111208	187429	203097
South Carolina	212393	144385	200372	173996	120311	199497	240000
Georgia	306734	296342	307519	315612	226532	335618	401979
Florida	36367	37560	40342	44065	16342	26389	20149
Alabama	115785	84009	104256	.....	.....	100000	96154
Mississippi	.....	.....	25050	23880	19075	32270	42550
Louisiana	.....	7945	12047	8496	4783	10051	12542
Arkansas	.....	.....	.....	.....	.....	.....	1000
Tennessee	13763	15909	.....	.....	.....	19445	25883
West Virginia	.....	25000	.....	.....	21559	28433	25335
Kentucky	9500	12050	15850	16200	17950	19550	18500
Ohio	45435	47244	44140	45645	63149	51192	.....
Michigan	.....	.....	.....	.....	.....	3500	.....
Indiana	26750	35000	38000	35000	45300	41900	.....
Wisconsin	.....	.....	.....	.....	.....	200	.....
Missouri	.....	.....	.....	.....	.....	2000	.....
Utah	.....	.....	.....	.....	.....	5530	.....
Total	.....	.....	.....	.....	.....	1624063	.....
Rest of U. S. (a)	.....	.....	.....	.....	.....	270854	.....
Grand total	.....	.....	.....	.....	.....	1894917	.....

a Purchases for farm use as reported in census of 1890, at average value for 1896, as shown by this table and Table 3.

Digitized by Google

TABLE 2.—VALUE OF COMMERCIAL FERTILIZERS CONSUMED IN THE UNITED STATES, BY STATES, 1891 TO 1897.

[Tons of 2,000 pounds.]

STATES.	1891.	1892.	1893.	1894.	1895.	1896.	1897 to Oct. 1.
Vermont	$298260	$ 308465	$ 323200	$ 346170	$ 370800	$ 401700	$ 408660
Connecticut	.....	.....	.....	675000	.....	600000	.....
New York	.....	2862653	.....	.....	.....	4621500	.....
New Jersey	1846482	1509921	1641615	1715767	1575840	1736298	.....
Pennsylvania	.....	3200000	3750000	3750000	3750000	3750000	3750000
Virginia	1711785	2142890	2281230	3914550	3914550	4034944	.....
North Carolina	2250000	1562670	2181990	1968645	1668120	2811435	3046455
South Carolina	3185895	2165775	3005500	2809940	1804665	2792958	3120000
Georgia	4601010	4445130	4612785	4734180	3397980	4698652	5225727
Florida	618239	688520	724156	710844	326840	580558	448278
Alabama	1736775	1260135	1563840	.....	.....	1400000	1250000
Mississippi	.....	.....	443980	425115	339674	575234	752238
Louisiana	.....	146982	222870	157176	88486	165842	206943
Arkansas	.....	.....	.....	.....	.....	.....	20000
Tennessee	344075	397725	.....	.....	.....	486125	647075
West Virginia	.....	625000	.....	.....	419604	574685	532164
Kentucky	237500	301250	396250	405000	448750	488750	462500
Ohio	1135875	1181100	1108500	1141125	1578725	1279800	.....
Michigan	.....	.....	.....	.....	.....	a87500	.....
Indiana	663750	1000000	950000	875000	1132500	1047500	.....
Wisconsin	.....	.....	.....	.....	.....	6000	.....
Missouri	.....	.....	.....	.....	.....	51500	.....
Utah	.....	.....	.....	.....	.....	110621	.....
Total	.....	.....	.....	.....	.....	32301582	.....
Rest of U. S. (a)	.....	.....	.....	.....	.....	5387287	.....
Grand total	.....	.....	.....	.....	.....	37688869	.....

a Purchases for farm use as reported in census of 1890.

RETURNS FOR CENSUS YEARS.

It is thought desirable to republish from the census reports of 1880 and 1890 the value of the fertilizers purchased by farmers within the year preceding June 1 of each of those years. These statistics may be found in Table 3.

The retail value of the fertilizers bought in 1880 was $28,586,397; in 1890 $38,469,598, or but slightly more than the wholesale value for 1896, shown in Table 2. The South Atlantic States lead all other geographical divisions in the value of fertilizers consumed, the North Atlantic stand second in order, and the South Central third.

Digitized by Google

TABLE 3.—VALUE OF FERTILIZERS PURCHASED, 1880 AND 1890, BY STATES AND TERRITORIES.

STATES AND TERRITORIES.	1880.	1890.	STATES AND TERRITORIES.	1889.	1890.
Maine	$ 212135	$ 456515	Minnesota	$ 93250	$ 61578
New Hampshire	165393	246293	Iowa	98567	86843
Vermont	127670	217397	Missouri	109724	65705
Massachusetts	653422	896560	Kansas	61713	25740
Rhode Island	140318	172900	Nebraska	20794	19269
Connecticut	497448	609649	South Dakota	.....	15675
New York	2715477	3627726	North Dakota	.....	8923
New Jersey	1601609	1837719	Montana	.....	4757
Pennsylvania	3525336	3384310	Wyoming	.....	1548
Delaware	487228	460465	Colorado	5195	25074
Maryland	2838465	2419826	New Mexico	10733	9217
District of Columbia	22352	16651	Arizona	.....	10
Virginia	2187283	2320260	Utah	11394	23211
North Carolina	2111767	2882288	Nevada	2526	2019
South Carolina	2659969	3867418	Idaho	.....	2137
Georgia	4846920	5724187	Washington	.....	11633
Florida	72642	857327	Oregon	10519	13370
Alabama	1200956	2421648	California	108732	148886
Mississippi	123258	789268	Oklahoma	.....	3817
Louisiana	278305	906348			
Texas	74797	58665	The United States	28586397	38469598
Arkansas	56314	93939			
Tennessee	157442	361097	SUMMARY BY GEOGRAPHICAL DIVISIONS.		
West Virginia	176300	210767			
Kentucky	145674	317231			
Ohio	550029	1602869	North Atlantic	9638806	11449069
Michigan	300995	173017	South Atlantic	14832926	18759139
Indiana	340582	777727	North Central	1928823	3067515
Illinois	174277	124977	South Central	2036741	4952013
Wisconsin	178892	105192	Western	149099	241862

PRODUCTION OF FERTILIZERS IN 1890.

The latest information with regard to the manufacture of fertilizers is shown in Table 4, which is taken from one of the reports of the census of 1890. This table includes fertilizers generally understood as such, but does not include chemicals used in the manufacture of fertilizers. This industry is one in which the value of materials forms an unusually large percentage of the value of the product, since it constitutes 64.1 per cent of that value, while in the case of all manufactures, taken collectively, the percentage is only 55.8.

The census report states that the apparent profit disclosed by this table is not a net profit, but is a gross profit, from which there remain to be deducted certain expenses which are not included in the column of "Miscellaneous expenses." If wages and salaries, cost of materials, and miscellaneous expenses are deducted from the value of products, a gross profit of 16.3 per cent is shown on the value of the capital.

Digitized by Google

TABLE 4a.—MANUFACTURES OF FERTILIZERS, 1890, BY STATES AND TERRITORIES

STATES AND TERRITORIES.	Number of establishments reporting.	Capital.					
		Aggregate.	Plant.				Live Assets.
			Total.	Land.	Buildings.	Machinery, tools and implements.	
Alabama	8	$709250	$175700	$7100	$74500	$94100	$533550
California	4	230500	72500	19000	15000	38500	158000
Connecticut	8	246223	164000	29800	72000	62200	82223
Delaware	17	1011589	315275	61875	175500	113900	660314
District of Columbia	3	73570	15380	3000	2000	10380	58190
Florida	3	14705	5500	300	3450	1750	9205
Georgia	44	5501881	1701587	241516	824713	635358	3800294
Illinois	4	914844	251749	55867	102582	93300	663095
Indiana	5	86120	23050	6500	8650	7900	63070
Kentucky	4	234585	79500	29000	32000	18500	155085
Louisiana	3	582347	135000	21000	66500	47500	447347
Maine	6	74530	20490	3400	4300	12790	54040
Maryland	53	6935914	1843383	430075	852100	561208	5092531
Massachusetts	16	1720605	165000	18500	66350	80150	1555605
Michigan	3	673900	291800	19000	101100	171700	382100
Mississippi	3	180532	42600	8000	17600	17000	137932
Missouri	4	209658	112835	15159	41890	55786	96823
New Jersey	27	3705914	1425296	332350	605682	487264	2280618
New York	31	3895779	1078212	220784	531800	325628	2817567
North Carolina	12	1513142	382652	81857	192300	158495	1130490
Ohio	22	1182510	464650	105302	183196	176152	717860
Pennsylvania	49	2719898	1476061	612364	411188	452514	1243837
South Carolina	10	5920218	2215289	444400	1055788	715106	3704929
Tennessee	4	380191	134764	33000	78511	23253	245427
Virginia	28	1795303	525200	117300	245850	162050	1270103
All other states and territories	9	80460	44150	4050	23200	16900	36310
The United States	390	40594168	13197623	2870499	5787740	4539384	2739654

Digitized by Google

TABLE 4b—MANUFACTURES OF FERTILIZERS, 1890, BY STATES AND TERRITORIES.

STATES AND TERRITORIES.	Value of products.	Cost of materials used.	Miscellaneous expenses.	Total wages.
Alabama	$765000	$519713	$48715	$60310
California	284500	179975	17938	52408
Connecticut	330450	247912	17904	42625
Delaware	1018438	696185	31277	81068
District of Columbia	93300	76700	4995	11450
Florida	86137	74075	1059	9905
Georgia	5026034	3098883	468599	484589
Illinois	924758	297685	53226	200574
Indiana	216812	156945	7215	16592
Kentucky	256169	172869	15382	31665
Louisiana	263678	157703	24919	59598
Maine	69020	41603	4354	12970
Maryland	6208025	3984178	459109	711548
Massachusetts	1910920	1119951	54910	204427
Michigan	753585	594767	53979	81400
Mississippi	326650	277005	6650	18248
Missouri	212716	124823	14362	49416
New Jersey	4319088	2882809	186485	591208
New York	3498291	2138915	217514	483717
North Carolina	994135	656769	89316	119494
Ohio	1287101	840787	73413	191029
Pennsylvania	2957316	2032218	304660	344238
South Carolina	4417658	2754407	490335	492015
Tennessee	267900	151100	44320	29100
Virginia	2475638	1739138	84556	260939
All other states and territories	217525	96759	14890	36298
The United States	39180844	25113874	2790082	4671831

Digitized by Google

TABLE 4c.—MANUFACTURES OF FERTILIZERS, 1890, BY STATES AND TERRITORIES.

STATES AND TERRITORIES.	Average number of employees and total wages.											
	Aggregates.		Officers, firm members, and clerks.				Operatives skilled and unskilled.					
			Males above 16 years.		Females above 15 years.		Males above 16 years.		Females above 15 years.		Children.	
	Average number.	Total wages.	No.	Wages.	No.	Wages.	No.	Wages.	No.	Wages.	No.	Wages.
Alabama	251	$60310	21	$17475	.....	.....	230	$42835	.....	.....	.....	.....
California	117	52408	6	7680	.....	.....	111	44728	.....	.....	.....	.....
Connecticut	150	42625	14	9265	.....	.....	134	32772	2	$585	.....	.....
Delaware	209	81068	22	14735	.....	.....	187	66333	.....	.....	.....	.....
Dist. of Columbia	31	11450	2	1664	.....	.....	29	9786	.....	.....	.....	.....
Florida	28	9905	5	5600	.....	.....	23	4305	.....	.....	.....	.....
Georgia	1428	484589	164	158578	.....	.....	1255	324479	4	1248	5	$284
Illinois	278	200574	30	57979	.....	.....	248	142595	.....	.....	.....	.....
Indiana	32	16592	6	7130	.....	.....	26	9462	.....	.....	.....	.....
Kentucky	62	31665	16	12491	1	$700	45	18474	.....	.....	.....	.....
Louisiana	105	59598	7	22350	.....	.....	88	34908	10	2340	.....	.....
Maine	44	12970	8	4030	.....	.....	36	8940	.....	.....	.....	.....
Maryland	1232	711548	179	218216	2	650	1047	490602	4	2080	.....	.....
Massachusetts	381	204427	29	36576	.....	.....	351	167676	1	175	.....	.....
Michigan	210	81400	14	13220	1	380	185	66760	.....	.....	10	1040
Mississippi	58	13248	6	2100	.....	.....	52	11148	.....	.....	.....	.....
Missouri	95	49416	7	8800	.....	.....	87	40382	1	234	.....	.....
New Jersey	1088	591208	123	138481	2	1205	927	440686	36	10836	.....	.....
New York	800	483717	110	158711	.....	.....	686	324390	2	416	2	200
North Carolina	374	119494	29	29092	2	542	333	87960	.....	.....	10	1900
Ohio	381	191029	53	40427	.....	.....	327	150507	.....	.....	1	95
Pennsylvania	745	344238	89	67299	.....	.....	641	274175	2	1000	13	1764
South Carolina	1182	492015	80	105630	.....	.....	1101	386350	.....	.....	1	35
Tennessee	78	29100	7	7500	1	600	56	16000	14	5000	.....	.....
Virginia	687	260939	86	96872	1	300	600	163767	.....	.....	.....	.....
All others	112	36298	9	7680	.....	.....	58	21870	12	2000	33	4748
United States.	10158	4671831	1122	1249584	10	4377	8863	3381890	88	25914	75	10066

PRODUCTION OF PHOSPHATE.

While the output of fertilizers as a whole is unknown for any year since 1890, yet statistics with regard to the phosphate industry for 1891 and 1892 have been published by the Department of Labor, and for 1891 to 1896 by the Geological Survey. The Department of Labor obtained its statistics by sending a special agent to the phosphate mines, where he entered upon schedules the information which that Department has since published. The method employed by the Geological Survey is to obtain information by means of the mail, addressing all operating phosphate miners whose names can be ascertained, and endeavor is made to make the list complete.

Tables 5 and 6, relating to phosphate production, are taken respectively from reports of the Department of Labor and the Geological Survey. They differ in their statements, and there are no facts available as an explanation of the differences beyond a statement of the methods employed in collecting the statistics.

Digitized by Google

TABLE 5.—QUANTITY AND VALUE OF PHOSPHATE MINED, ACRES CONTROLLED, CAPITAL INVESTED, AND NUMBER AND WAGES OF EMPLOYEES.

[From the special report of the Commissioner of Labor on the Phosphate Industry of the United States, page 91. The period covered by the table is the last obtainable complete fiscal year each mine was operated between 1890 and 1892, inclusive.]

LOCALITY AND NUMBER OF MINES.	Phosphate mined.		Quantity shipped (tons of 2240 pounds).	Controlled for mining purposes.		Capital invested in—		Expenditure for labor.	Employees engaged in production.	
	Quantity (tons of 2240 pounds	Value at mine.		Acres.	Miles of river.	Plant.	Land.		Average number.	Average yearly earnings.
Florida.										
88 land mines.....	371190	$ 2186153	268718	179848	.....	*a* $1329582	*b* $9600067	*c* $ 737557	*d* 3499	$ 211
18 river mines....	160837	635696	151715	.....	*a* 163½	*e* 811000	*a* 1746000	144154	416	347
Total.....	532027	2821849	420433	179848	*a* 163½	*f* 2140582	*g* 11346067	*c* 881711	*d* 3915	225
N. Carolina.										
1 land mine.....	700	2800	700	2500	.....	2000	100000	1215	18	68
S. Carolina.										
23 land mines.....	429976	2641992	379276	69790	.....	1272000	*f* 2865000	*c* 1239·91	*h* 4314	287
7 river mines....	269000	*i* 1686500	233000	.....	*j* 7	1291200	55000	*c* 851198	*h* 928	378
Total.....	698976	*i* 4328492	612276	69790	*j* 7	2563200	*f* 2920000	*k* 1590689	*l* 5242	303
Grand total.....	1231703	*l* 7153141	1033409	252138	*m* 170½	*f* 4705782	*n* 14366067	*o* 2473615	*p* 9175	270

a Not including 3 mines not reporting.
b Not including 8 mines not reporting.
c Including the expenditures for officials and clerks in one mine.
d Not including 1 mine not reporting.
e Not including 2 mines not reporting.
f Not including 5 mines not reporting.
g Not including 11 mines not reporting.
h Not including skilled labor in 1 mine and not reporting.
i Not including 1 mine with a product of 600 tons not reporting.
j Not including 6 mines not reporting.
k Including the expenditures for officials and clerks in 2 mines.
l Not including skilled labor in two mines not reporting.
m Not including 9 mines not reporting.
n Not including 16 mines not reporting.
o Including the expenditures for officials and clerks in three mines.
p Not including all labor in 1 mine and skilled labor in 2 mines not reporting.

Digitized by Google

TABLE 6.—PRODUCTION OF PHOSPHATE ROCK, 1891 TO 1896.

[From the Eighteenth Annual Report of the United States Geological Survey, 1896-97.]

STATE.	1881.		1892.		1893.	
	Quantity.	Value.	Quahtity.	Value.	Quantity.	Value.
Florida:	*Long tons.*		*Long tons.*		*Long tons.*	
Hard rock			*a* 155908	$ 859276	215685	$ 1117732
Soft rock	57982		6710	32418	13675	64626
Land pebble			21905	111271	86624	359127
River pebble	54500		*b* 102820	415453	122820	437571
Total	112482	$ 703013	287343	$ 1418418	438804	$ 1979056
South Carolina:						
Land rock	844978	$ 2187160	243658	$ 1236447	308485	$ 1408785
River rock	1305:8	760978	150575	641262	194129	748229
Total	475596	$ 2948138	394228	$ 1877709	502564	$ 2157014
Grand total	587988	$ 3651151	681571	$ 3296127	941368	$ 4136070

a Includes 52,708 tons of land rock carried over in stock from 1891.
b Includes 12,120 tons of river pebble carried over in stock from 1891.

TABLE 6.—PRODUCTION OF PHOSPHATE ROCK, 1891 TO 1896.—*Continued.*

STATE.	1894.		1895.		1896.	
Florida:	*Long tons.*		*Long tons.*		*Long tons.*	
Hard rock	326461	$ 979383	307098	$ 1302096	296811	$ 1067525
Soft rock			6916	32000	400	2300
Land pebble	98885	296655	181011	593716	97936	176972
River pebble	102307	390775	73036	185090	100052	300556
Total	527653	$ 1666813	568061	$ 2112902	495199	$ 1547353
South Carolina:						
Land rock	307305	$ 1252768	270560	$ 898787	267072	$ 792457
River rock	142803	492808	161415	512245	135351	389192
Total	450108	$ 1745576	431975	$ 1411032	402423	$ 1181649
Tennessee	19188	$ 67158	38515	$ 82160	26157	$ 57370
North Carolina					7000	17000
Grand total	996949	$ 3479547	1038551	$ 3606094	930779	$ 2803372

PRODUCTION AND CONSUMPTION OF PHOSPHATE FOR THE WORLD.

The world's production and consumption of phosphate are shown in Table 7, which is taken from the Special Report of the Commissioner of Labor on the Phosphate Industry, pages 101-102.

It appears that in 1891 the production of phosphate in the world was 1,587,133½ tons, the statements for all foreign countries being, however, in round numbers. France stands next to the United States in production, and Belgium third. The consumption is shown to be very nearly equal to the production, the United States leading with 517,187 tons, the United Kingdom following with 300,000 tons, and Germany with 250,000 tons.

Digitized by Google

The estimates for foreign countries given here were made by Mr. Hermann Voss. Another estimate of consumption, which the Commissioner of Labor regards as more trustworthy, makes the total for those countries 1,069,946½ tons instead of 1,030,000 tons, as here given. This would make the world's consumption 1,587,133½ tons in 1891.

TABLE 7.—THE WORLD'S PRODUCTION OF PHOSPHATE, 1891.

[Tons of 2,240 pounds.]

COUNTRIES PRODUCING.	TONS.
The United States	757133½
France—Somme and Ardennes	400000
West Indies—Aruba, etc	50000
Belgium—Mons and Liege	200000
Canada	20000
Germany—Lahn	40000
England (coprolites)	20000
Russia, Norway, and other countries	100000
Total	1587133½

THE WORLD'S CONSUMPTION OF PHOSPHATE, 1891.

[Tons of 2,240 pounds.]

COUNTRIES CONSUMING.	TONS.
The United States	517187
United Kingdom of Great Britain	300000
Germany	250000
France	150000
France (in the raw state)	200000
Belgium and Holland	75000
Other countries	55000
Total	1547187

IMPORTS AND EXPORTS OF FERTILIZERS.

The Bureau of Statistics of the Treasury Department has obtained statistics of the imports and exports of fertilizers and fertilizer materials for a series of thirteen years, from 1884 to 1896. The quantities of fertilizers cannot be ascertained in all cases, but all fertilizers are represented for value. Table 8 shows the imports and Table 9 the exports.

Digitized by Google

It appears that 375,733.93 tons of fertilizers were imported during 1896, not including fertilizers, for which tonnage is not given, and that the total value of all fertilizers imported in that year, including those for which tonnage is not given, was $7,376,615.

AVERAGE VALUE PER TON.

The average value per ton imported and exported is given in Tables 8 and 9, and in these tables it appears that the average ton imported, not including fertilizers whose tonnage is not given, was valued in 1896 at $19.04, while the exported ton was valued at $8.56. The tons of fertilizers exported in 1896 were 514,143, and the value of all fertilizers exported, whether expressed in tons or not, was $4,400,593.

TABLE 8.—IMPORTS OF FERTILIZERS AND FERTILIZER MATERIALS, 1884 TO 1896

ARTICLES.	YEAR.	TONS.	VALUE.	VALUE PER TON.
Ammonia, sulphate of	1884	0.06	$ 8 00	$ 133 33
	1885	1.56	19 00	12 18
	1886	1116.41	50482 00	45 22
	1887	426.06	17275 00	40 55
	1888	32.76	1553 00	47 41
	1889	89.57	4272 00	47 69
	1890	143.76	7175 00	49 91
	1891	9904.32	483196 00	48 79
	1892	4953.30	236085 00	47 66
	1893	7012 88	315802 00	45 03
	1894	2170.50	125869 00	57 99
	1895	7137.49	358238 00	50 19
	1896	12270.70	480971 00	39 20
Apatite	1885	891.00	8466 00	9 50
	1887	360.00	4342 00	12 06
	1890	126.00	1297 00	10 29
	1892	37.50	653 00	17 41
	1893	64.00	1021 00	15 95
	1894	165.00	1239 00	7 51
	1895	121.00	2124 00	17 55
	1896	434. 00	3030 00	6 98
Ashes, wood and lye of, and beet-root ashes	1884	.....	19717 00	.....
	1885	.....	23238 00	.....
	1886	.....	28022 00	.....
	1887	.....	36283 00	.....
	1888	.....	44592 00	.....
	1889	.....	38989 00	.....
	1890	.....	40098 00	.....
	1891	.....	42624 00	.....
	1892	.....	54855 00	.....
	1893	.....	76306 00	.....
	1894	.....	74050 00	.....
	1895	.....	77708 00	.....
	1896	.....	67394 00	.....

Digitized by Google

TABLE 8.—IMPORTS OF FERTILIZERS AND FERTILIZER MATERIALS, 1884 TO 1896.—*Continued.*

ARTICLES.	YEAR.	TONS.	VALUE.	VALUE PER TON.
Blood, dried	1884	.....	$ 4356 00	.....
	1887	.....	5003 00	.....
	1888	.....	2743 00	.....
	1889	.....	3955 00	.....
	1890	.....	1338 00	.....
	1891	.....	1594 00	.....
	1892	.....	1397 00	.....
	1893	.....	72684 00	.....
	1894	.....	4068 00	.....
	1895	.....	1014 00	.....
Bone dust or animal carbon and bone ash, fit only for fertilizing purposes	1884	8734.43	183553 00	$ 12 01
	1885	6861.42	115437 00	16 82
	1886	21235.01	351390 00	16 55
	1887	22314.97	412926 00	18 50
	1888	1605.14	22056 00	13 74
	1889	4585.69	57447 00	12 53
	1890	3219.12	59095 00	18 36
	1891	6614.00	122717 00	18 55
	1892	6587.95	128398 00	19 49
	1893	7875.00	152642 00	19 38
	1894	3378 00	44747 00	13 25
	1895	3195.00	41777 00	13 08
	1896	2983.00	37992 00	12 74
Bone, crude, not manufactured, burned, calcied, ground, or steamed	1884	.....	191505 00	.....
	1885	.....	162985 00	.....
	1886	.....	310731 00	.....
	1887	.....	59244 00	.....
	1888	.....	195979 00	.....
	1889	.....	318351 00	.....
	1890	.....	345511 00	.....
	1891	.....	332911 00	.....
	1892	.....	348310 00	.....
	1893	.....	360305 00	.....
	1894	.....	301554 00	.....
	1895	.....	305043 00	.....
	1896	.....	154610 00	.....
Cotton-seed meal and cake	1896	325.61	3170 00	9 74
Guano	1884	28090.50	588033 00	20 93
	1885	19975.29	393039 00	19 68
	1886	14383.37	341647 00	23 75
	1887	12981.41	338467 00	26 07
	1888	8041.90	154937 00	19 27
	1889	14406.78	289745 00	20 11
	1890	8431.82	111811 00	13 26
	1891	11169.50	194157 00	17 38
	1892	4199.00	61264 00	14 59
	1893	4170.00	71700 00	17 19

Digitized by Google

TABLE 8.—IMPORTS OF FERTILIZERS AND FERTILIZER MATERIALS, 1884 TO 1896 —*Continued.*

ARTICLES.	YEAR.	TONS.	VALUE.	VALUE PER TON.
Guano	1894	5165.00	$ 96605 00	$ 18 70
	1895	4751.00	72514 00	15 26
	1896	5072.29	52697 00	10 39
Kieserite, kyanite or cyanite, and kainite	1884	126166.67	757014 00	6 00
	1885	84219.65	483780 00	5 74
	1886	102391.36	650689 00	6 35
	1887	76551 04	446018 00	5 83
	1888	57500.22	327565 00	5 70
	1889	96788.24	599468 00	6 19
	1890	62871.25	422225 00	6 72
	1891	85876.84	605309 00	7 05
	1892	105873 00	666458 00	6 29
	1893	65537.00	419760 00	6 40
	1894	76143.00	493972 00	6 49
	1895	78008.00	441915 00	5 66
	1896	67192.91	320765 00	4 77
Lime	1884	5350.50	26370 00	4 93
	1885	5467.60	28270 00	5 17
	1886	8285.50	41307 00	4 99
	1887	13223 90	57226 00	4 33
	1888	25854 80	92923 00	3 59
	1889	29728 50	110228 00	3 71
	1890	38648 10	134259 00	3 47
	1891	40020.80	167729 00	4 19
	1892	28398.24	115359 00	4 06
	1893	29000.11	114418 00	3 95
	1894	22110.50	87513 00	3 96
	1895	23575.87	90293 00	3 83
	1896	21403.02	76302 00	3 57
Oil cake	1884	13.60	1683 00	123 75
	1885	408.56	10495 00	25 69
	1886	1387.91	38633 00	27 84
	1887	2070.99	58512 00	28 25
	1888	2201.16	58392 00	26 53
	1889	2167.56	52831 00	24 37
	1890	1477.09	38577 00	26 12
	1891	1337.03	23846 00	17 84
	1892	5353.56	106811 00	19 95
	1893	3641.78	82916 00	22 77
	1894	3749.76	37170 00	9 91
	1895	3255.93	47386 00	14 55
	1896	8911.50	52867 00	5 93
Phosphates, crude or native	1884	16542.00	237594 00	14 36
	1885	21418.56	264079 00	12 33
	1886	37980.50	432591 00	11 39
	1887	26334.04	247911 00	9 41
	1888	28669.76	248427 00	8 67
	1889	34407.47	333957 00	9 71
	1890	31179.33	309764 00	9 93
	1891	32882.80	287057 00	8 73

Digitized by Google

TABLE 8.—IMPORTS OF FERTILIZERS AND FERTILIZER MATERIALS, 1884 TO 1896. —*Continued.*

ARTICLES.	YEAR.	TONS.	VALUE.	VALUE PER TON.
Phosphates, crude or native	1892	26197.00	$ 192733 00	$ 7 36
	1893	21526.00	130696 00	6 07
	1894	28942.00	123714 00	4 27
	1895	24130.00	159169 00	6 60
	1896	20562.29	153370 00	7 46
Potash, muriate of	1884	24356 38	731409 00	30 03
	1885	20419.85	613674 00	30 05
	1886	23412.00	721736 00	30 83
	1887	19900.30	592432 00	29 77
	1888	28032.59	822089 00	29 33
	1889	36051.56	1067344 00	29 61
	1890	31470.35	928457 00	29 50
	1891	37927.18	1182007 00	31 17
	1892	35210.72	1094122 00	31 07
	1893	36693.59	1180044 00	32 16
	1894	40832.09	1280795 00	31 37
	1895	44754.06	1361218 00	30 42
	1896	43438.35	1372743 00	31 60
Potash, sulphate of	1884	173.17	6227 00	35 96
	1885	5.94	190 00	31 99
	1886	325.94	10850 00	33 29
	1887	998.16	38986 00	39 06
	1888	723.87	27038 00	37 35
	1889	2799.57	89173 00	31 85
	1890	744 86	26599 00	35 71
	1891	1362.60	49619 00	36 41
	1892	3162.73	112780 00	35 66
	1893	6923.39	251792 00	36 37
	1894	5988.63	229975 00	38 40
	1895	7762.01	273392 00	35 22
	1896	7423.67	269810 00	36 34
Soda, nitrate of, or cubic nitrate	1884	60601.15	1983378 00	32 73
	1885	54680.90	1696056 00	31 02
	1886	50608.11	1681824 00	33 23
	1887	86145.96	2614162 00	30 35
	1888	89477.01	2449639 00	27 38
	1889	75574.99	2275093 00	30 10
	1890	102381.92	2709131 00	26 48
	1891	109862.56	2929760 00	26 67
	1892	117982.45	2976818 00	25 23
	1893	104648.94	3063012 00	29 27
	1894	98719.04	2785073 00	28 21
	1895	138953.92	4124711 00	29 68
	1896	145456.64	3870734 00	26 61
All substances not otherwise specified	1884	9842.67	85086 00	8 64
	1885	10897.00	223292 00	20 49
	1886	21364.66	358170 00	16 76
	1887	23381.35	323704 00	13 84
	1888	16948.80	250844 00	14 80

Digitized by Google

TABLE 8.—IMPORTS OF FERTILIZERS AND FERTILIZER MATERIALS, 1884 TO 1896. —*Concluded.*

ARTICLES.	YEAR.	TONS.	VALUE.	VALUE PER TON.
All substances not otherwise specified	1889	28149.67	$ 348521 00	$ 12 38
	1890	21277.38	333109 00	15 66
	1891	14792.45	221467 00	14 97
	1892	21625 50	398655 00	18 43
	1893	25042.68	445286 00	17 78
	1894	25652.00	393075 00	15 32
	1895	27103.00	374646 00	13 82
	1896	40259 95	460160 00	11 43

TABLE 8.—IMPORTS OF FERTILIZERS AND FERTILIZER MATERIALS, 1884 TO 1896

SUMMARY.

YEAR.	TONS.	VALUE.	VALUE PER TON.
1884	279871.13	$ 4815933 00	.....
1885	225247.33	4023020 00	.....
1886	282490.77	5018072 00	.....
1887	284688.18	5252491 00	.....
1888	259088.01	4698777 00	.....
1889	324749.60	5589374 00	.....
1890	301970.98	5468446 00	.....
1891	351750.08	6613993 00	.....
1892	359580.95	6494698 00	.....
1893	312135.37	6738384 00	.....
1894	313015.52	6079419 00	.....
1895	362747.28	7731148 00	.....
1896	375733.93	7376615 00	.....
Total	4033069.13	$ 75930370 00	.....

Digitized by Google

SUMMARY FOR ARTICLES REPRESENTED BY TONS.

1884		$ 4600355 00	$ 16 44
1885		3836797 00	17 03
1886		4679319 00	16 56
1887		5151961 00	18 10
1888		4455463 00	17 20
1889		5228079 00	16 10
1890		5081499 00	16 83
1891		6266864 00	17 82
1892		6090136 00	16 94
1893		6229089 00	19 96
1894		5699747 00	18 21
1895		7347383 00	20 25
1896		7154611 00	19 04
Total		$71821303 00	$17 81

TABLE 9.—EXPORTS OF FERTILIZERS FROM THE UNITED STATES, 1884 TO 1896

YEAR.	TONS.	VALUE.	VALUE PER TON.
1884	161352	$ 1096021 00	$ 6 79
1885	136976	910778 00	6 65
1886	173031	1107657 00	6 40
1887	220792	1397534 00	6 33
1888	194271	1255028 00	6 46
1889	129539	988569 00	7 63
1890	227593	1618681 00	7 11
1891	231915	2182274 00	9 41
1892	251104	2657120 00	10 58
1893	460062	3927343 00	8 54
1894	542718	5038445 00	9 28
1895	638586	5741262 00	8 99
1896	514143	4400593 00	8 56

ANALYSIS OF FERTILIZERS AND LICENSE OF SALE.

All the states east of the Mississippi River, with Missouri, Arkansas, and Louisiana—twenty-nine in number—have laws relating to the inspection and sale of commercial fertilizers. The region subject to this legislation is the fertilizer-consuming region of the country, the remainder of the states using comparatively insignificant quantities. The occasion for this legislation was the fraudulent character of the commercial fertilizers manufactured and offered for sale, the chemical constituents of which were misrepresented or concealed, and were of much less value than represented by manufacturers and dealers.

The laws of the various states with regard to the sale of fertilizers differ only in minor details, and in general are of the following character:

Digitized by Google

The General System.

The secretary of the state board of agriculture, or some other state official, is authorized to issue licenses for the sale of fertilizers, upon the payment of a fee for each brand or specified quantity, annually, and the licensee must affix to each package of fertilizer sold a statement of the chemical analysis of the fertilizer, his own name and address, and the net weight of the package, a copy of said certificate to be sent to the state official, together with a sample of the fertilizer. The state official employs a chemist to analyze samples of fertilizers, and the results of analyses are published, together with statements of the commercial value of the various brands as shown by the quantities of their various components. A regular analysis of each brand of fertilizer is usually made annually, but the state officials may authorize anyone to select from any package of fertilizer exposed for sale a small quantity and send the same to him for analysis, to see whether it agrees with the certificate attached to the package.

The result of the legislation requiring the analysis of fertilizers has been to eliminate fraud from the business, and the farmer may now be sure that he is buying what the fertilizer is represented to be, his main concern being that he should buy the fertilizer that is chemically adapted to the requirements of his soil and crops.

ABSTRACT OF FERTILIZER LAWS.

Alabama.

Certificate must be attached to each package of 200 pounds or less, and one additional certificate to each package containing each additional 200 pounds or fractional part thereof. The certificate must state the number of pounds contained in the package, the name of the manufacturer, and place of manufacture, and give an analysis showing portions of nitrogen, water soluble phosphoric acid, citrate soluble phosphoric acid, acid soluble phosphoric acid, and potash contained therein.

The exemptions from the fertilizer law are common lime, land plaster, cotton seed, cotton-seed meal, ashes, and common salt, not in combination.

The license fee is $1 for each 200 pounds or fractional part thereof.

Any person selling, or offering for sale, any fertilizers without first submitting the statement required by law to the Commissioner of Agriculture, is to be fined not more than $500, and any one who sells fertilizer which does not have a certificate attached for each 200 pounds, or fraction thereof, must be fined not less than $50. No unlicensed person can deal in fertilizers without being subject to a fine of not less than $100, and anyone who commits a fraud in the manufacture or sale of fertilizers must be fined not less than $100.

Arkansas.

The percentage of ammonia, potash, and soluble, reverted, and insoluble phosphoric acid must be stated in the certificate of analysis.

Digitized by Google

A fine of $100 is to be paid for each violation of the law.

For each brand an analysis fee of $15 is charged.

The law exempts fertilizers worth $10 and less per ton from the provisions of the fertilizer act.

Connecticut.

Certificate must be attached to each package of fertilizer, showing the number of net pounds of fertilizer contained therein, the name, brand, or trade-mark under which the fertilizer is sold, the name and address of the manufacturer, and the place of manufacture, and the chemical composition of the fertilizer.

Fertilizers exempted from the law are stable manure and locally manufactured products having a less value than $10 a ton.

The law forbids the sale of pulverized leather, raw, steamed, roasted, or in any form, as fertilizer without explicit printed certificate of the fact affixed to every package.

The license fee is $10 for each of the fertilizing ingredients contained in or claimed to exist in said fertilizer, and every violator of the law is subject to a fine of $100 for the first offense and $200 for each subsequent violation.

Delaware.

Marl, barnyard manure, lime, ashes, plaster, and chemicals used in compounding fertilizers are exempt from the provisions of the law.

The percentage of ammonia, of potash soluble in water, of available phosphoric acid, and of insoluble phosphoric acid must be stated in the certificate of analysis.

Any misstatement of analysis is subject to a penalty of $200 for the first offense and $300 for each subsequent one, while a failure to send a copy of the certificate of analysis to the state chemist subjects the offender to a fine of $100 for the first offense and $150 for each subsequent one.

For each brand a fee of $30 is paid.

Florida.

The exemptions are barnyard or stable manure, crude cotton seed, marl, lime, plaster, and chemicals to be used in compounding artificial manures.

The certificate of analysis must state the percentage of ammonia, potash soluble in water, available phosphoric acid, and the source from which the same is derived, and the insoluble phosphoric acid, and all other ingredients of which the fertilizer is composed.

For misrepresenting the analysis the penalty is $200 for the first offense and $300 for each subsequent one, and the penalty for failure to file a certificate of analysis with the Commissioner of Agriculture is $100 for the first offense and $150 for each subsequent one.

The fee is twenty-five cents per ton.

Digitized by Google

Georgia.

The certificate to be filed with the state official is to show the proportions of the ingredients, as follows: moisture at 212 degrees F., insoluble phosphoric acid, available phosphoric acid, ammonia, actual and potential, potash (K_2O).

The law forbids the sale of the following: any acid phosphate which contains less than 10 per cent of available phosphoric acid, any acid phosphate with potash which contains a sum total of less than 10 per cent of available phosphoric acid and potash when the percentages of the two are added together; any acid phosphate with ammonia which contains a sum total of less than 10 per cent of available phosphoric acid and ammonia when the percentages of the two are added together; any acid phosphate with ammonia and potash which contains a sum total of less than 10 per cent of available phosphoric acid, ammonia, and potash when the percentages of the three are added together; all cotton-seed meal which is shown by official analysis to contain less than 7½ per cent of ammonia. No brands shall be sold as ammoniated superphosphates unless said brands contain 2 per cent or more of ammonia.

The license fee is 10 cents per ton and the penalty is that of a misdemeanor.

Illinois.

A certificate must show a chemical analysis, stating the percentage of nitrogen, or its equivalent in ammonia, in available form, of potash soluble in water, and of phosphoric acid in available form (soluble or reverted), as well as the total phosphoric acid.

The license fee is $20 for each manufacturer, importer, or agent, but the law does not apply to fertilizers, the prices of which is $10 a ton or less.

The penalty for violation is a fine of not less than $200 for the first offense, and not less than $500 for every subsequent one, but a deficiency of 1 per cent or less of the nitrogen, potash, or phosphoric acid claimed to be contained is not considered as evidence of fraudulent intent.

Indiana.

The analysis must show in an available form the percentage of nitrogen, or its equivalent in ammonia, of potash soluble in water, of soluble and reverted phosphoric acid, and of insoluble phosphoric acid.

The exemptions from the law are barnyard manure, marl, lime, wood ashes, and plaster.

A violator of the law pays $50 for the first offenses and $100 for each subsequent one.

Each analysis calls for a fee of $2, and labels must be obtained from the state officials at $1 per hundred.

Kentucky.

Such analysis must be made as is approved by the director of the Kentucky Agricultural Experiment Station, and the label that must be at-

Digitized by Google

tached to each package must state the money value of the contents, computed from their composition.

The law does not apply to fertilizers worth $10 and less per ton.

The fee for each analysis is $15, and besides this the vender must obtain labels from the state official and pay $1 per hundred.

For each violation of law the penalty is not less than $100 nor more than $500.

Louisiana.

The certificate of chemical analysis must state the proportions of nitrogen, soluble phosphoric acid, reverted phosphoric acid, insoluble phosphoric acid, and potash, with such additional ingredients as the fertilizer may contain.

The inspection fee is fifty cents per ton. The person who sells fertilizers without a license is subject to a fine not exceeding $1,000, while a person who sells fertilizers which has not been tagged, although having a license, is guilty of a misdemeanor and subject to a fine of $250 for each offense and $150 for each omitted tag. The sale of fraudulent fertilizers is forbidden; suits at law cannot be maintained for collecting the price thereof, and all fertilizers not legally tagged are presumed to be fraud, ulent.

The law is not applicable to lime, land plaster, cotton-seed meal, ashes, and common salt.

Maine.

The law does not apply to fertilizers worth $10 and less per ton. The required certificate of analysis is the same as that for Illinois, and continues from year to year unless a change is made in the composition of the fertilizer.

A fee of $10 must be paid for the phosphoric acid, and $5 each for the nitrogen and potash, for each brand of which thirty tons or more are sold.

The penalty for violation of law is $100 for first offense and $200 for each subsequent one, with the proviso that the percentages of ingredients must be substantially smaller than those claimed by the vender.

Maryland.

In the certificate of analysis there must be a statement of the percentage of nitrogen, or its equivalent in available ammonia, of potash soluble in distilled water, and of available phosphoric acid.

The fee is $15 per brand, but the act does not apply to fertilizer materials, nor to special contracts.

The penalty for selling without a license is $100 for the first offense and $200 for each subsequent one; for adulterating or changing the constituents of fertilizers as certified, or for using another manufacturer's trade mark, the penalty is a fine of not more than $200, or imprisonment not exceeding six months, or both; the penalty for not reporting brands and agents to the Maryland Agricultural College is $25 for the first offense and $50 for each subsequent offense.

The law does not apply to fertilizers selling for $10 or less per ton.

Digitized by Google

Massachusetts.

A chemical analysis must be made from which to state the percentage of nitrogen of potash soluble in distilled water, and of phosphoric acid in available form (soluble in distilled water and reverted), as well as the total phosphoric acid.

No one is to sell any pulverized leather, hair, or wool waste, raw, steamed, roasted, or in any form, as a fertilizer, without an explicit printed certificate of the fact affixed to every package.

Penalty for violation of law is $50 for first offense and $100 for each subsequent one.

There is an analysis fee of $5 each for nitrogen, phosphorus, and potassium.

Michigan.

The law is applicable to fertilizers which exceed $10 per ton value. Certificate of analysis to state the percentage of nitrogen in an available form, of potash soluble in water, of phosphoric acid in available form (soluble and reverted), and of insoluble phosphoric acid.

The license fee is $20 for every brand, and the penalty for violation of law is a fine of not less than $100 for the first offense, and not less than $300 for each subsequent one.

Mississippi.

The exemptions from the provisions of the fertilizer law are animal excrement, cotton seed, and unmixed cotton seed products, whether natural or artificial.

In the statement of analysis there must be mentioned the percentage of nitrogen in available form, of potash soluble in water, and of phosphoric acid in available form, soluble or reverted, and of insoluble phosphoric acid.

Adulterated fertilizer, or that which does not conform to the certificate, is to be forfeited to the county, and contracts for it are void. Counterfeiting or using false tags is forgery.

For each analysis there is a fee of $15, and the charge for tags enough for one ton of fertilizer is thirty cents.

Missouri.

The approval of the director of the Missouri Agricultural Experiment Station must be given to the form of analysis, which must state the essential ingredients of the fertilizer in plain language and be void of all technical terms. The label must state also the money value of the fertilizer, computed from its composition.

Each analysis calls for a fee of $10, and the labels are $1 per hundred.

For the first offense against the law the penalty is $100; for each subsequent one $200.

Digitized by Google

New Hampshire.

The percentage of ammonia, nitrogen, soluble phosphoric acid, insoluble phosphoric acid, potash, and other constituent parts, must be shown in the certificate of analysis.

For a license to sell fertilizers a fee of $50 must be paid, and for selling without a license $500 must be paid, one-half of which goes to the prosecutor. For want of a label on each package, or for a false statement on a label, the fine is $20 for the first offense and $40 for each subsequent one, one-half to go to the prosecutor.

New Jersey.

The certificate of analysis must state the percentage of ammonia, or its equivalent of nitrogen; of potash in any form or combination, soluble in distilled water; of phosphoric acid in any form or combination; of portion of phosphoric acid soluble in distilled water; that portion soluble in a neutral solution of citrate ammonia at a temperature not exceeding 100 degrees F., and that portion of phosphoric acid not soluble in either of the above named fluids. The material from which the phosphoric acid is obtained must also be stated. This certificate of analysis must accompany every package of over 100 pounds.

The license fee is $15 for each analysis, and the penalty for violation of law is $50 for the first time and $100 for each subsequent time.

New York.

The law requires that the statement of analysis shall exhibit the percentage of nitrogen; available phosphoric acid, or, in case of undissolved bone, percentage of total phosphoric acid; percentage of potash soluble in distilled water.

It is to be regarded as a violation of law if the number of pounds in a package is less than that certified, if the name and address of the manufacturer or name of the brand of fertilizer is misstated, and, in case of undissolved bone, if there is less than 1 per cent of total phosphoric acid.

The penalty for violation of law is $100.

Fertilizers selling for $10 and less per ton are exempt from the operation of the law.

No license fee is provided for.

North Carolina.

Cotton-seed meal is not subject to the law.

In the certificate of analysis there must be a statement of the soluble and precipitated phosphoric acid, which should not be less than 8 per cent; the ammonia, which should not be less than 2 per cent, or its equivalent in nitrogen.

A tax of twenty-five cents is placed upon each ton.

Any fertilizer not up to the requirements of the law in composition, or any untagged fertilizer, is subject to seizure and sale by order of court.

The penalty for violating the law is $10 for each package.

Digitized by Google

Ohio.

A chemical analysis must show the percentage of nitrogen, or its equivalent in ammonia, in available form; of potash soluble in water, and of phosphoric acid in available form (soluble or reverted), as well as the total phosphoric acid.

The license fee is $20 for each brand, and the penalty for violation of law is a fine of not less than $200 for the first offense and of not less than $500 for each subsequent one.

Pennsylvania.

The certificate of chemical analysis must state the percentage of nitrogen, or its equivalent in ammonia, in available form; of potash, soluble in water; of soluble and reverted phosphoric acid, and of insoluble phosphoric acid.

The fee is $10 for each article of fertilizer sold during the preceding year if the amount sold was less than 100 tons; if the amount was 100 tons and over, but less than $500 tons, the fee is $20; and if the amount was 500 tons or more, it is $30; but if no sales were made in the preceding year the fee is $10.

The penalty for violation of the law is a fine of not less than $25 nor more than $100 for the first offense, and not less than $200 for each subsequent offense, half of which goes to the informer.

The law does not cover barnyard manure, marl, lime, and wood ashes, nor any commercial fertilizer which contains none of the constituents to be mentioned in the certificate of the chemical analysis.

Rhode Island.

The exemptions from the law are fertilizers worth less than $10 per ton, except that packages of such fertilizers must be accompanied by a label giving a correct statement of composition.

The analysis certificate to state the percentage of nitrogen, of potash (K_2O) soluble in distilled water, and of soluble, reverted, and insoluble phosphoric acid (P_2O_5).

For each ingredient of the fertilizer the license fee is $6.

The first violation of the law subjects the offender to a fine of $50; each subsequent one $100.

Pulverized leather must bear a printed certificate that it is pulverized leather.

South Carolina.

All chemical compounds for use as fertilizers are covered by the law, including "burnt marl, kainit, ground bone, fish scrap, tankage, cotton-seed meal, etc."

The chemical analysis must show the real percentage of soluble and precipitated phosphoric acid, soluble potassa, ammonia, or its equivalent in nitrogen.

A tax of twenty-five cents per ton must be paid.

For violating the fertilizer law there is a penalty of $10 for each package.

Digitized by Google

Tennessee.

A certificate of analysis must show the percentage of ammonia, potash, and available phosphoric acid in such form as may be prescribed by the Commissioner of Agriculture.

A fee of fifty cents must be paid on each ton or fraction of a ton sold.

The law does not apply to home-made manures.

A fine of $200 must be paid upon conviction of violation of the law, except that failure to send a sample of the fertilizer received by a dealer to the Commissioner of Agriculture subjects the former to a fine of not less than $50 nor more than $100.

Vermont.

The law applies to fertilizers containing two or more of the following elements: nitrogen, ammonia, potash, and phosphoric acid.

The exemptions from the law, in addition to those indicated by the preceding, are bone meal, land plaster, lime, or any substance or product of nature not compounded, and fertilizers worth less than $10 per ton.

The analysis certificate must state the percentage of nitrogen, of potash soluble in distilled water, and of phosphoric acid in available form, soluble in distilled water and reverted, as well as total phosphoric acid. The fee for a license to sell is $100.

Pulverized leather must bear a printed certificate of its nature.

For the first violation of law the penalty is $50, and for each subsequent one $100.

Virginia.

A registration fee of $100 is required, which entitles a manufacturer or dealer to register not exceeding ten brands; each brand above ten calls for a fee of $10, but anyone manufacturing not more than 100 tons in one year pays a tax of $10 only. The certificate of analysis must show the percentage of ammonia, available phosphoric acid, insoluble phosphoric acid, and potash soluble in water, and any other ingredient.

One who sells fertilizer without having a license is subject to a fine not exceeding $1,000, and anyone who does not attach to each package a statement of the analysis may be fined not less than $50 in each case.

The law does not apply to lime, land plaster, ashes, common salt, nor to any chemicals used in manufacturing fertilizers.

West Virginia.

The prescribed certificate of analysis must make the same statement as that called for by the law of Illinois, and in addition to this there must be written or printed on the label the value per ton, to be computed from the composition of the fertilizer.

The making of a false certificate to the director of the West Virginia Agricultural Experiment Station is perjury. The penalty for sale without analysis, as provided, is $50 to $500, and the penalty for removing, altering, or transferring the label, or selling without a label, is $10 to $50; for any other violation, $10 to $100.

Digitized by Google

There is a fee of $10 for each fertilizer ingredient and fifty cents per 100 labels.

Wisconsin.

The law applies to fertilizers which are worth more than $10 per ton, and the certificate of analysis is the same as that required in Illinois.

The license fee is $25 per brand, and the penalty for violation of law is $100 for the first offense and $200 for each subsequent one.

OUR FORESTAL RESOURCES FROM AN ECONOMIC STANDPOINT.

BY ALLEN CHAMBERLAIN, IN NEW ENGLAND MAGAZINE.

The attitude of the people of the United States toward the subject of the rational treatment of forests, both public and private, has until recently been most discouraging to the few who for years have worked earnestly to secure a recognition of the merits of their plea in the legislative bodies, both state and national. The federal government has made a beginning, at least, by establishing several governmental timber reserves and in maintaining a corps of efficient scientific men to inquire into our forest resources. Several states in the East and West have seen the wisdom of establishing forestry commissions for the purpose of studying the subject, and some have adopted legislation and provided the requisite machinery to make it effective, which will, at least, reduce the terrible waste of forest fires. Finally New York has come forward and appropriated $1,000,000 to be expended in establishing a forest preserve in the Adirondacks. This was achieved in the face of opposition from wealthy private and corporate owners of forest property in that region, who raised the cry of "vested interests." But beyond all these governmental advances the attitude of some of the large lumber and pulp operators is particularly encouraging. When these men came to realize fully that the timber supply was not inexhaustible and that certain fundamental laws of nature must be taken into account in the management of forest property; in other words, when their pockets began to be affected, they called their brains into play and studied the economics of the situation. The result is that in New England to-day some of the largest operators are voluntarily restricting their cut to trees of a given diameter at the stump, and are urging their neighbors to do likewise. Manufacturing and agricultural interests have felt the financial pinch resulting from periods of drought and freshet, and in New Hampshire have besought the legislature to protect their interests through the preservation of the forests about the head waters of the rivers.

One of the greatest bugaboos with which this country has had to contend from its very beginning as a nation has been that false interpretation of democracy, that every man should be allowed to conduct his personal affairs according to his own dictation without let or hindrance, and that the government's duty is to protect him in the exercise of this right, be-

Digitized by Google

yond this the government being of little or no use. Men waded deep in "vested interests," meanwhile keeping a jealous eye upon the government machinery, lest it should at any time show an inclination toward the hated paternalism of European nations. This was free America, and every citizen must be free to do with his own as he listed without regard to the effect of his actions upon his neighbors and the community. The natural outcome of all this is the rapid development of selfishness in private affairs and indolence in the affairs of the government.

The chief forester of Germany many years ago recognized these to be the principal obstacles to forest development everywhere, and in a treatise which he published on the science of forestry he said: "The forest is of importance not only in the present time and for the proprietor alone, but it has a great bearing also upon the future and the whole population. Only indolence and selfishness can ignore such irrefutable truths. To proceed against both as they become a danger to the commonwealth is a duty of legislation." It is much easier to undertake such proceedings in a monarchy than in a republic like our own. This is not owing to the superiority of the monarchy over the republic; it is because selfishness and indolence have for over a century been bred into our fibre that it is strong within the men we choose to make our laws. As far as forestry legislation is concerned, it is certain that the people are waking up, and if their eyes can but be fully opened before it is too late we may yet possess the finest government forestal system of the world.

We must first of all recognize the fact that it is contrary to the old established common law to permit a man to administer his property to the direct injury of his neighbor; and we must pocket our foolish prejudices and go to the Old World for models in this forestry business. European laws need not be adopted by us *in toto;* but they are capable of being revised and adapted to our uses, as has already been suggested by Professor Sargent and his colleagues in their report to the Secretary of the Interior. These older countries established elaborate forestry systems to cope with just such evils as are to-day threatening our land. The wanton handling of the forests carrres in its train a horde of natural ills. In Germany, for instance, whole districts, once flourishing agricultural places, were reduced to poverty and want and in some instances were entirely wiped out of existence through the destruction of the forests. On the seacoasts the cutting of the forests exposed once fertile plains to the all-devastating sands; in the interior the light and undulating soil was replaced by sand hills, large and small, and where forests once stood and served to carry off the stagnant moisture the spots were converted into pestilential marshes. The mountains themselves, when despoiled of their timber, lost by erosion the vegetable loam deposited through centuries, and to-day can scarcely sustain the poor little heather and broom grasses. In the valleys the rich meadows vanished, having been repeatedly washed and torn by the torrents poured down from the naked mountain slopes, and the high moors, which took their places, emit at all times of the year vapors and fogs which kill vegetation far into the land. The soil has

Digitized by Google

been directly impoverished and the climatic conditions changed for the worse. This was the tale told by a German writer during this century as an example of the result of private greed. How weak the argument is that the government has no right to interfere with the freedom of private ownership of woodlands is shown by the sequel; if any injury is done to the welfare of other interests in the state through mismanagement of the woodlands, the state has to bear the burden in the consequent shrinkage of values.

The history of the forestry movement in Germany and France is interesting reading, and it may be sketched here in a brief space. At the beginning of the Christian era the greater part of Germany was covered by a dense primeval forest, and the people regarded the woods as a block in the path of their progress. Our forefathers looked at the woods in the same light when they began the settlement of this country. Timber was a drug in the market; it was cleared land for agriculture that was wanted. This idea of the worthlessness of the forests continued in Germany until the twelfth century, when in many parts of the country wood was becoming very valuable by reason of its scarcity. Then the rulers rose in their might and enacted stringent laws to check the evil, and the death penalty was imposed upon any who wantonly destroyed the woodlands. In 1713 one Hans Carl von Carlowitz wrote in a work entitled "Sylvicultura O Economica": "From the little information we have of the condition and quality of woods it must be acknowledged that within the last few years more wood has been consumed in the middle European countries than could grow in several centuries. From this it is easy to see what the end must be. The trees are destroyed, the forests that make a country prosperous are gone, the mountains and hills are bare." Here was a man, early in the eighteenth century, who recognized that the forests make a country prosperous; and yet men had not begun to think of all the bearings which the forests had upon the welfare of the people of the earth, of its effect upon the water supply and power, upon agriculture and upon general sanitation. The ancients seem to have known something of these matters, for Plato speaks in the "Crito" of "the sickening of the country because of deforestation." Science has contributed much to the knowledge of the world since that time, and to-day we know something, at least, on all those points; yet we remain selfish and indolent while one of our greatest interests is being rapidly undermined.

A scarcity of the funds in the state treasury first led the authorities of Thuringia, now one of the chief forest districts of Germany, to a more careful cultivation of their woodlands, as a means of replenishing their coffers. The Thuringian forests to-day cover over fifteen hundred square miles—the total area of the district is about seventy-five hundred square miles, with a population of about one and a half millions—and are the chief source of income to some of its provinces. Forest legislation was first enacted in Erfurt in 1359, and in the sixteenth century it became general there, and during the following century the planting of young trees was encouraged by the government.

Digitized by Google

In France the effect of politics and general governmental indolence is clearly seen in her forestal history. In Germany the forests were cultivated as a means of replenishing the public exchequer; in France when funds ran short the forests were drawn upon to make good the deficiency. They burned their candle at both ends and left a terrible bill for posterity to pay. Since 1827 the country has been laboriously but courageously repairing the untold injury committed by the profligacy of past generations. Wholesale deforestation seems to have been delayed in France until the time of Louis XIV. After the death of Colbert, Louis' sagacious minister of finance, the kingdom fell into bad ways and debts accumulated rapidly. Colbert had noticed the waste of the woodlands during his lifetime, and is reported to have exclaimed at one time that the destruction of the forests was the destruction of France. On the death of the "Grand Monarch" affairs grew even worse. The brief regency of Philippe, Duke of Orleans, was most ill advised, and the reign of Louis XV. was altogether indolent and apathetic. Such conditions tended to the greatest extravagancies at court, and, added to this, Louis XV. was constantly embroiled with his neighbors in long and costly wars. The royal forests and those of the people, in 1750, twenty-four years before Louis XV. died, amounted to twenty-seven per cent of the country's area. They were even then being drawn upon for court funds. Louis XVI. did his weak best to straighten out finances and relieve the people; but his early ministers of finance were too sound for a nobility that had been heretofore pandered to in every whim, and they were forced one after another to resign. Finally the servile courtier Calonne became minister of finance, and under him the national debt was increased by the borrowing of fifty million pounds sterling. His successor was equally profligate, and on his dismissal in 1788 the records show that France had under forest cover only 14.8 per cent of her territory, a reduction of almost 50 per cent in less than forty years. Soon after came the fever of the French revolution, and in its midst, 1791, a forestal inventory of the nation showed the percentage of woodland to be but 10.9 per cent. The accuracy of this figure is somewhat problematical, considering the wild state of the times, but it is probably high enough. In 1827, during the reign of Charles X, a law was enacted which looked to the reforesting of the waste places, and creating a government supervision of woodlands. By scientific methods, great expense and yet the greatest economy, the forest area of France was increased to 15.1 per cent of the country's area in 1881, and it is steadily increasing. It required nearly a century to reforest the territory destroyed in three short years.

The timber waste in the United States to-day is equally shocking with that of the time of the thriftless kings of France; and the redemption will be equally as tedious and costly unless we take a vigorous hold upon the matter at once. While Germany and France are not the only European countries which practice scientific forestry (Austria, Italy, and Switzerland also pay great attention to the subject), they are the leaders, and more is known of their work than that of the other countries. Even Japan is

Digitized by Google

giving greater heed to this subject than the United States, and for several years past has been educating young men in the advanced forestry schools of Germany at government expense. These schools, which are of three grades, to educate men for the various ranks of forest work, are like all educational institutions, the bedrock of the nation's success. Why shouldnot forestry be taught in our own agricultural colleges, in our technical schools and universities? In most of these there are already taught certain branches of this science, such as botany to a certain extent, road building, map drawing and surveying, and political economy. It would not be a difficult matter so to extend the study of botany as to include forest economics, though we should be much handicapped at the present day, it is true, by the lack of such systematized forests as are now ready to hand in all European districts and bear no small part in the education of the young foresters and guards. Our government educates men for its army and navy at the national expense. Why not provide for the education in the forestry schools of Germany and France of a limited number of bright young fellows each year? The government even now owns a sufficient amount of valuable wild timber land in the West which is much in need of skilful attention to warrant such a course, and these men educated at the government's expense could serve there for a stated period of active work, as our naval cadets serve a cruise after graduation in payment for their education. It might even be advisable for the government to engage a limited number of trained forest managers from Europe to take charge of our governmental timber tracts until such time as we shall have educated men of our own for the work. There are plenty of such men, graduates of the best European schools, who are on the waiting lists at home.

About a dozen years ago the federal government made a beginning in the line of forestry enquiry by establishing a division in the Agricultural Department for this purpose. During this time the work of the division has steadily advanced, and it is each year furnishing the country wiht much valuable information as to our forest resources both public and private, urging lumbermen to see the advantages of a rational use of their woodlands, and assisting states in the framing of laws for forest government. Its duties are purely of a missionary nature; but it is an invaluable public office even in its somewhat restricted field. Whatever the nation knows to-day of the status of the woodlands has been chiefly ascertained by this bureau; but with the limited funds at its command and with a wide range of field for their expenditure, little that is exact has been learned. By the most painstaking canvass possible under the circumstances certain conservative estimates have been reached, and on these, the most reliable data we have, this article is based. From the census returns of some of the older eastern states it appears as if the woodland areas were increasing rapidly, and this has led many to protest against what seems to them a needless alarm about our forestal conditions. If these people would take the pains to look further, they would in almost every case find that much of the territory described in the census returns as woodland is in

Digitized by Google

fact no better than brushland. In the main, it is to be feared that the census enumerators are incapable of distinguishing between the two moreover their reports on such matters are not always the result of their personal investigations, but are based on the mere "say so" of the owners or local authorities. Some of this brushland may in time develop into valuable growth, but much of it is a miserable waste of scrub, through which fire runs at regular intervals each year, thus impoverishing the soil and killing out any sapling of worthy varieties which may be growing there. Even the best of these brushlands are growing chiefly only hard woods, the conifers being discouraged by the frequent fires. Anyone at all conversant with the condition of the lumber trade to-day must know that the most useful of all our woods, the white pine, has its end already in sight. The stock of spruce is likewise much depleted and rapidly approaching extinction. Those who maintain that the woodland areas are increasing in some localities cannot show anything which will replace the once vast pineries. As a matter of unquestionable fact, however, our national consumption of wood for all purposes is so enormous as to be almost beyond comprehension; according to the most conservative estimates we are using each year half as much again as our woodlands can grow.

From the carefully kept records of the German government forest administration it is ascertained that the annual growth of wood per acre in that country averages not over 55 cubic feet, though sometimes under unusually favorable conditions it has approached 100 cubic feet. These figures, however, include branches and small fagots such as American prodigality throws away. Considering only such wood as is used in this country, our timber at the age of 125 years, it is figured, could not have grown more than 35 cubic feet per acre each year. Our present forest area (about four hundred and sixty million acres, exclusive of Alaska and much brush and waste land) amounts to a little more than 25 per cent of the total area of the country. Of this seven-tenths are on the Atlantic side, one-tenth on the Pacific, one-tenth in the Rockies, and one-tenth scattered over the interior of the western states. If this timber acreage were well stocked and well managed, it could not produce our annual consumption, which is at least twenty-five billion cubic feet, or nearly fifty cubic feet per acre. It is known, however, that much of it is poorly stocked and with poor timber, and that it is not cared for as forest property is cared for in European countries; in fact, the bulk of it receives no attention whatever.

From 1887 to 1892 the saw mill consumption of the United States increased over 35 per cent, and it is safe to say, at least, that the increase since the last date has been 25 per cent. Hardly 6 per cent of all this is exported in any form, either raw or manufactured. Our importation of wood material is less than 1 per cent of our consumption, outside of fine cabinet woods. Assuming that the amount of wood now, standing on every acre of our whole forest area is ten thousand feet board measure, which is deemed an extravagant estimate, our woodlands could not supply our demands for much over one hundred years, the time which it

Digitized by Google

requires to produce a good saw-log. And yet our legislators have seen fit to place an import duty on lumber; in other words, they have put a premium on forest destruction. In considering this act and its certain effects, one feels like charging these legislators with a lack of patriotism and of public interest. Certain it is that they showed themselves needlessly ignorant of all these plain facts, which were ready to their hand in the office of the Department of Agriculture.

Let us look for a moment at the condition of our wooded area a little more in detail. The New England and the southern states have to-day about 50 per cent of their territory under wood; but in the former the merchantable timber has been mostly cut off. A rough but liberal estimate of the amounts of timber standing in the several regions which are ready for cutting shows the following figures: southern states, 700,000,000,000 feet board measure; northern states, 500,000,000,000; Pacific coast, 1,000,000,000,000; Rocky Mountains, 100,000,000,000,—in all 2,300,000,000,000 feet. At the present rate of cutting, our woodlands can scarcely be expected to last more than a hundred years.

Herein is food for much reflection. It shows that with an average growth of certainly not better than 35 cubic feet per acre the total annual consumption is 50 cubic feet, or more than the entire present forest area of the country could grow under the best scientific management. Every citizen should know these facts and bestir himself to see that a remedy is provided. Each year, nay, each day that this matter is delayed means the eventual increase of the burden on the public to restore this resource to a sound basis. Place no import duties on foreign lumber; enact and enforce stringent laws which will put a stop to the wasteful forest fires which annually burn over something like ten million acres and entail a loss of twenty-five million dollars (in Europe the damage by forest fires amounts to but a few thousands annually); and encourage through state legislation the planting of woodland on areas now wholly useless for other purposes. No undertaking is of greater general public importance than this. It affects every line of business in the country to a marked degree. The climate, the health of the country, the water supply, manufactures, agriculture, all depend directly upon the forests.

Our national forest resources, that is, timber land to which the government holds title, are practically unknown at present, but a very modest estimate by Professor B. E. Fernow, chief of the Forestry Division of the Agricultural Department, places the area at about fifty million acres. Of this nearly thirteen million acres are already permanent forest reservations by virtue of presidential proclamation, and over three and a quarter million acres are in the several national parks, the Yellowstone, Yosemite, Sequoia, General Grant, and Hot Springs, of Arkansas. President Cleveland added over twenty-one million acres of forest preserves just at the close of his administration, but through the efforts of some of the western congressmen these were ordered to be held in suspense until March 1 next. This action was secured on the representation of the Congressmen that the interests of the people of the West were being vastly injured by

Digitized by Google

the reservation of these tracts. Did these men honestly represent the people at large, the people who sent them to Washington to look out for their interests? We have it on the published authority of Mr. John Muir, a man who knows much of the western mountain forest country and its people, more intimately probably than any other, and who traveled with the scientific committee which went out to study these lands a year ago on behalf of the government, that "probably more than ninety per cent of people in the states in which the new reservations lie are in favor of them, or at least of some form of government protection and control." This he learned from talking with "all sorts of settlers—miners, merchants, prospectors, etc.," and he could not recall "a single instance in which objection was made to a rational government forest policy by anyone not interested in plunder." If those interested in plunder prove stronger at Washington than the bulk of the people, we shall see those new reservations suspended next March for another year or two; and meantime the squatting and pillaging goes on more rapidly than before so as to secure all that there is of any value before the government wakes up to its duty.

As far as the national parks are concerned, they never were intended to be considered as sources of timber supply, and they appear to be efficiently policed by the regular army. The timber country, reserved and unreserved, is wholly without protection and as open to the raids of the tree butchers and railroads as ever they were before a government forest policy was thought of. Those sections of the government timber land which have already been reserved should at least be accorded adequate protection at once from fire and from thieves, and the government should begin without delay to educate and organize a corps of competent foresters to conduct these woodlands.

With New York's example in establishing a state timber reserve, other commonwealths which still possess any considerable amount of woodland will be likely to follow suit before many years. The demand for trained forest managers will therefore be constantly increasing. It will also become the duty of the several states to encourage energetically tree plantations on land which is now useless for any other purpose. Few realize how much of such territory exists all over the country. Professor Fernow is authority for the statement that of the entire country's area only 18 per cent is improved, and the long-settled Atlantic coast still possesses 65 per cent of unimproved land, of which 43 per cent is estimated to be woodland. To show more closely the percentages of waste land and woodland in the several sections of the country, the following table will prove helpful. This is condensed from a fuller statement compiled by the government forestry bureau with the aid of the most reliable information obtainable. It should be borne in mind, however, that only approximations in such matters are possible. These percentages are based on the total land areas of the several divisions.

Digitized by Google

STATES	Imp'v'd Land.	Br., For., Waste Ld	Probably Forest.	Brush.
New England	27	73	52	..
N. Y., N. J., Penn., Del., Maryland	50	50	28	..
Virginia, N. Car., S. Car., Georgia	27	73	49	..
Florida, Alabama, Miss., La	16	84	50	..
Texas	12	88	23	..
Michigan, Wisconsin, Minnesota	25	75	43	..
Ohio, Indian, Illinois	69	31	13	..
Lake States	43	57	31	..
W. V., Ky., Tenn., Ark., Mo	35	65	48	..
Iowa, N. D., S. D., Neb., Kan., Ok	30	70	4	..
Interior States	32	68	20	..
Mon., Wyoming, Col., N. Mex	1	99	13	20
Idaho, Nevada, Utah, Arizona	0.7	99.3	8	22
California, Oregon, Washington	8	92	30	27

It is not in accordance with the popular theory of republicanism to urge that this government should control more forest property or should exert authority over private holdings. Even in Germany the government supervision became so unpopular at one time that in 1811 private forests were relieved from this restraint. In a few instances it worked well, but in the main proved most unsatisfactory, and so much against the interests of the community at large that in 1875 state supervision was partially restored. The following year a law was enacted which encouraged the stocking of waste lands with forest trees; and under this act the communities are, under certain conditions, held to grow wood on such of their uncultivated lands as are not suitable for permanent agricultural or industrial purposes. In these cases the state contributes in part the funds necessary, but only in the poorer communities. Even to suggest that sooner or later this country of ours must adopt some such plan will be regarded as heretical to-day; but in no other way can the matter be safely handled. The German government owns to-day 32 per cent of the country's forests, France owns 12 per cent of hers, the United States, on the basis of 13 million acres of existing forest reservations, 2.8 per cent, and on the basis of 50 million acres of government owned forest lands, 10.87 per cent.

Americans may be good economists in private affairs, but in the business of the nation we give too little thought. We have in this country 82 per cent of waste land, while in Germany there are only 5.3 per cent of pasture and sterile country. To be sure we have some eighteen times as much territory as Germany, and only about a third greater population, or 35 acres *per capita* against 2 1-3 acres, but the proportion is still beyond all reason. It has been shown that the Atlantic coast states, the longest settled of any part of the country, possess 65 per cent of unimproved territory. This is encouraged by our lack of public forethought. It would be much better business to have small returns from this territory than none at all as now. If it is possible to handle forest tracts profitably in

Digitized by Google

Germany, it is equally possible in the United States. One instance will suffice to illustrate the success of such work in Germany. In the duchy of Saxe-Meiningen there are nearly 104,000 acres of forest, where in are employed about 200 officials, and the annual expense of maintenance, including salaries, rents, travelling expenses, horses, cultivation, cutting, road building, tools, aid to students, and losses by gratuities, amounts to nearly $166,000; and yet the annual net profit by the sale of wood, etc., amounts to nearly $250,000. Their policy is to make every acre yield its full quota, and to make use only of that material which stands for the earned income of the property. Our policy is in the main to live upon our forest principles, thus reducing our resources at the rate of over $100,000,000 per annum, according to the census estimate of the value of our forest products. The government estimates that we have 460 million acres of woodland in the country, exclusive of brush land. Let us throw out 60 millions and call it an even 400 million. This territory, under rational management, should yield an average income of 50 cents per acre per annum, which is only one-half of the average yield of Germany's forests. This would mean an earned income twice as large as the sum we are spending to-day out of our principal. It is time that this matter was regarded from a business standpoint and conducted accordingly.

Digitized by Google

Digitized by Google

INDEX

Digitized by Google

Digitized by Google

INDEX.

PAGE

Adjournment, Annual meeting 61
Alfalfa by irrigation 292
Alfalfa, Facts about 85
  Chemical composition 85
  Hay 85
American, Association of Fairs and Expositions, Report of delegate to 59
American Shorthorn Breeders' Association, Report of Delegate to 57
Ammonia 300
Annual address by President Doolittle 8
Annual meeting 6
  Adjournment 61
Apiary in Nebraska, The 63
Appointments by President Doolittle 10
"Artesian" spring, Illustration of 213, 227
Ascaris equorum 264
Ascaris lumbricoides 263
Ascaris mystax 264
Auditing Committee appointed 43
  Report by 43
Beet sugar factories in the United States 82
Beet sugar industry, The 82
Board of Managers appointed 60
  Report by 46
Bordeaux mixture 96
Botanical regions and districts of Nebraska, The 109
Botanist, Report of the 107
  Botanical regions and districts of Nebraska, The 109
  Forage problem in Central Nebraska, The 115
  Forage problem in eastern Nebraska, The 111
  Forage problem on the high plains, The 117
  Grasses at the State Fair 107
  Hay, Prairie 124
  Map of phytogeographical regions and districts of Nebraska 110
  Nebraska, The botanical regions and districts of 109
  Pastures, native, Manuring 130
  Pastures, native, Tame grasses sown on 131
  Pastures, The renewing of native prairie 128
  Pastures, native, Weeds of the 128
  Phytogeographical regions and districts of Nebraska, Map of 110

Digitized by Google

PAGE
Box-elder bug 247
Illustration of 248
Remedies 250
Chemist, Report of the 183
Tests of seeds 183
Choanotaenia infundibuliformis 268
Conservation of rain 206
Copper carbonate, ammoniacal solution of 97
Corn, Indian, yield compared with Kaffir corn 102
Kaffir 102
Mature, Report by superintendent of 57
Cornstalk disease 321
County collective exhibits, Score of 62
County reports in detail 74
Cracks and fissures in our soil 207
Cultivation in relation to moisture 206
Dairy department 67
Davainea cesticillus 271
Delegate to American Association of Fairs and Expositions, Report by 59
Delegate to American Shorthorn Breeders' Association, Report by 57
Diseases, Mixtures for plant and fruit 96
Ammoniacal solution of copper carbonate 97
Bordeaux 96
Spraying apparatus 98
Stock solutions of lime and copper 97
Doolittle, President, Annual address by 8
Appointments by 10
Recommendations by 9
"Dug-out" spring, Illustration of 214
Election of officers 60
Engineer, Report of the 233
Camp Clark station on the North Platte river 234
Columbus station on the Platte River 235
Crawford station on the White river 241
Fort Niobrara station on the Niobrara river 242
Gering station on the North Platte river 234
Miscellaneous measurements 242
Norfolk station on the South Fork Elkhorn river 239
St. Paul and Columbus stations on the Loup river 236
Superior station on the Republican river 240
Entomolgist, Report of the 247
Box-elder bug 247
Remedies 250
Illustration of 248
Ceresas bubalus 250
Leptocoris trivitattus 247

Digitized by Google

PAGE
Entomologist, Report of the 247
White grubs 254
Remedies 255
Experiment stations and scientific knowledge, Importance of, to the farmer 311
Farm products, Fertilizing value of 100
Feeding standard, Wolff's 91
Feeding stuffs, Fertilizing value of 100
Fertilizer industry 352
Average value per ton 362
Imports and exports of fertilizer 361
Laws 368
Consumed in the United States 353
Manufacture 356
Phosphate 360
Production of Phosphate 358
Quantity 352
Value 352
World's production of phosphate, The 361
Fertilizing value of farm products 100
Fertilizing value of feeding stuffs 100
Fish food in Nebraska streams 272
Forage crops, Experiments with 305
Sorghum 309
Forage problem in central Nebraska 115
Forage problem in eastern Nebraska 111
Forage problem on the high plains 117
Forestal resources from an economic standpoint 376
Forestry, Division of 336
Consumption and waste wood 345
Forest biology 341
Forest influence 338
Forest measurement and finance 343
Forestry, technology and timber physics 346
Propaganda 351
Reservations 351
Tree planting in forestless regions 348
Furnas, Robt. W., Portrait ..... Frontispiece
Geologist, Report of the 195
Annual precipitation, Table showing 209
Annual rainfall 211
"Artesian" spring, Illustration of 213, 227
Artesian wells 226
Capillarity assisted and evaporation checked 205
Comparison of agricultural and mineral products 195
Conservation of rain 206

Digitized by Google

PAGE
Geologist, Report of the 195
Cracks and fissures in our soil 207
Cultivation in relation to moisture 206
Depth and cost of wells 224
"Dug out" spring, Illustration of 214
Geological section 229
Ground water 212
Means of bringing to the surface 212
Wind mills and water lifters 216
Home made windmills, Illustration of 217
Irrigation laws 226
Jumbo windmill, Illustration of 218
Map showing river system 203
"Merry-go-round" mill, Illustration of 220
Monthly precipitation 209
Precipitation and imbibation compared 208
Relation of precipitation to the growing season 209
Reservoirs, Illustrations of 222
Salt well 230
Soil, moist, Importance of the 210
Storage reservoir, The 221
Water as a soil element, The value of 195
Water, capillary 205
Water, Free, or ground water 205
Water, Hydroscopic 206
Water needed by growing crops, The 210
Water question, Importance of the 196
Waters, storm, The absorption of 206
Water, The absorption or imbibation of 204
Gigantorhynchus gigas 267
Gooseberries 330
Grain will shrink, How 300
Grasses at the state fair 109
Grasses, Native 61
Hay 85
Hay, Prairie 124
Hendershott, O. P., The case of 60
Hen fruit 294
Henry, R. H., Resignation of 6
Heterakis 265
Hog cholera and swine plague, Remedy for 298
Horse, The up-to-date, and the export demand 301
Irrigation, Some practical facts about 94
Status of, in Nebraska 283
Kaffir corn 102
Food constituents of Kaffir corn and Indian corn 103
Yield compared with Indian corn 102

Digitized by Google

PAGE
Legislative Committee, Appointment of 45
Letter of transmittal 3
Lime and copper, Stock solutions of 97
MacLean, Welcome by Chancellor 8
Manure 101
Manure, Value per ton 101
Manuring native pasture 130
Map of phytogeographical regions and districts of Nebraska 110
McIntyre, Annual report by 11
Meeting, Annual 6
Meeting, Semi-annual 6
Members of Board 6
"Merry-go-round" mill, Illustration of 220
Meteorologist, Report of the 141
January 142
February 143
March 144
April 145
May 146
June 147
July 148
August 149
September 150
October 151
November 152
December 153
For the year 154
Meteorological data 155
Miscellaneous 281
Mixtures for plant and fruit diseases 96
Moore suit, Report by Committee in 59
Mortgage indebtedness of Nebraska 87
Nebraska mortgage indetedness 87
Nematodes 263
Nominations 55
Committee on, appointed 55
Our type—Duroc Jersey 288
Paragraphs of interest to the farmer 312
Parasites of chickens, Internal 267
Pastures, Native, Manuring 130
Native, Tame grasses sown on 131
The renewing of native prairie 128
Needs of the native 128
Phytogeographical regions and districts of Nebraska, Map of 110
Plant and fruit diseases, Mixtures for 96
Pollenization of fruits, The 331

Digitized by Google

PAGE
Potatoes, Irish, Planting 298
Precipitation and imbibation compared 208
Annual, Table showing 209
Monthly 209
Relation of, to the growing season 209
President Doolittle, Annual address by 8
Appointments by 10
Recommendations by 9
Rainfall, Annual 211
Red hog, up-to-date, The 290
Report, Annual, by Secretary 12
Crops 14
Financial 12
List of time warrants 35
List of warrants 19
Report, Annual, by Treasurer McIntyre 11
by Auditing Committee 43
by Board of Managers 46
by Committee in Moore suit 59
by Committee on Resolutions 45
by delegate to American Shorthorn Breeders' Association 57
by general superintendent 58
by superintendent of gates 56
by superintendent of mature corn exhibit 57
by delegate to American Association of Fairs and Expositions 59
of the botanist. *See* Botanist, Report of the.
of the chemist. *See* Chemist, Report of the.
of the engineer. *See* Engineer, Report of the.
of the entomologist. *See* Entomologist, Report of the.
of the geologist. *See* Geologist, Report of the.
of the meteorologist. *See* Meteorologist, Report of the.
of the veterinarian. *See* Veterinarian, Report of the.
of the zoologist. *See* Zoologist, Report of the.
Reservoirs, Illustrations of 222
Resignation of R. H. Henry 6
Resolutions, Committee on, Appointment of 45
Roses, How to prune 329
Salt well 230
Sclerostoma equinum 265
Score of county collective exhibits 62
Secretary, Annual report by 12
Crops 14
Financial 12
List of time warrants 35
List of warrants 19
Semi-annual meeting 5

Digitized by Google

PAGE
Sheep industry, The problem of the 316
Silo, absorption of odor 330
Silos and silage, Facts about 89
Sorghum as a forage crop 98
Sorghum compared with Kaffir and Indian corn 99
Spiroptera microstoma 266
Spraying apparatus 98
Statistical report for 1897 68
Storage reservoirs, The 221
Sugar, Consumption of, in the United States 84
Sugar crop, The world's 83
Superintendent, Corn exhibit, Report by 57
Superintendent, General, Report by 56
Superintendent of gates, Report by 58
Taenia, crassicollis 263
Taenia serialis 262
Taenia serrata 262
Tanning material, New 301
Treasurer McIntyre, Annual Report by 11
Trees on Nebraska plains 313
Tree planting on forestless regions 348
Trichinella spiralis 266
Veterinarian, Report of the 187
Anthrax 190
Black leg 191
Hog cholera 193
Immunity, acquired 187
Inherited 187
Natural 187
Theory as to the cause of 189
Pleuro pneumonia 191
Rabies 190
Rinderpest 191
Tetanus 191
Texas fever 192
Variola 191
Warrnts, List of 10
Time, List of 35
Water as a soil element, The value of 195
Capillary 205
Free or ground water 205
Ground 212
Means of bringing to the surface 212
Windmills and water lifters 216
Hydroscopic 206
Storm, The absorption of 206
The absorption or imbibation of 204

Digitized by Google

PAGE
Welcome by Chancellor MacLean 8
Wells, Artesian 226
Cost of 224
Depth and cost of 224
Wheat crop of the world, The 297
White grubs 254
Remedies 255
Whitmore, W. G., Address by 284
Feeders, Source of 286
Feeding grain 285
Windbreaks 211
Windmills and water lifters 216
Windmills, Home-made, Illustration of 217
Wolff's feeding standard 91
Zoologist, Report of the 257
Ascaris equorum 264
Ascaris mystax 264
Choanotaenia infundibuliformis 270
Collection of parasites at the patho-biological laboratory, The 261
Davainea cesticillus 271
Fish food in Nebraska streams 272
Gigantorhynchus gigas 267
Heterakis 265
Internal parasites of chickens 267
Nematodes 263
Ascaris lumbricoides 263
Sclerostoma equinum 265
Spiroptera microstoma 266
Taenia crassicollis 263
Taenia serialis 262
Taenia serrata 262
Trichinella spiralis 266

Digitized by Google

Digitized by Google

Digitized by Google

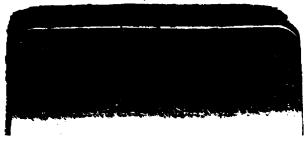
Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

UNIV. OF MICH.
MAY 2 1907



Digitized by Google